

M.L. Engineering (Plymouth) Limited



THE COMPANY

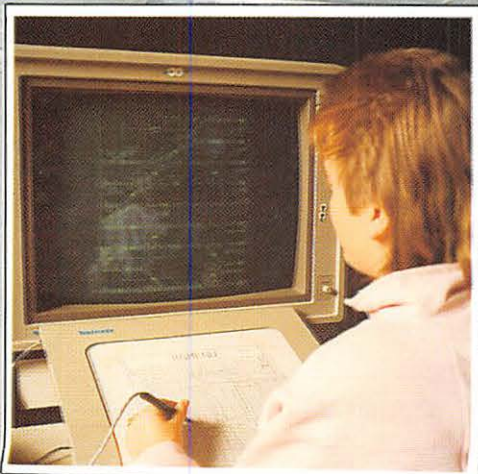
M.L. Engineering (Plymouth) Ltd., is a wholly owned subsidiary of M.L. Holdings P.L.C., which has a group turnover in excess of sixty-five million pounds sterling and employs over a thousand people.

M.L. Engineering (Plymouth) Ltd., was formed in 1959 to provide a complete design, production and installation service for a world-wide Railway Signalling industry. Since that time M.L. has also become a prominent supplier of Industrial Electronic Equipment.

A separate Industrial Controls Group specialises in Turnkey Projects involving Telemetry, Remote Control and Data Acquisition systems, utilising microprocessor and computer based techniques.

In 1982, the manufacturing and engineering activities were brought together in a custom built factory complex at Estover on the outskirts of Plymouth.

To enhance design efficiency and flexibility the company has also invested in a new system of Computer Aided Design. This, coupled to a high quality production facility, with a progressive policy in engineering, makes the company an acknowledged front-runner in all aspects of modern Signalling and Industrial Control Equipment.



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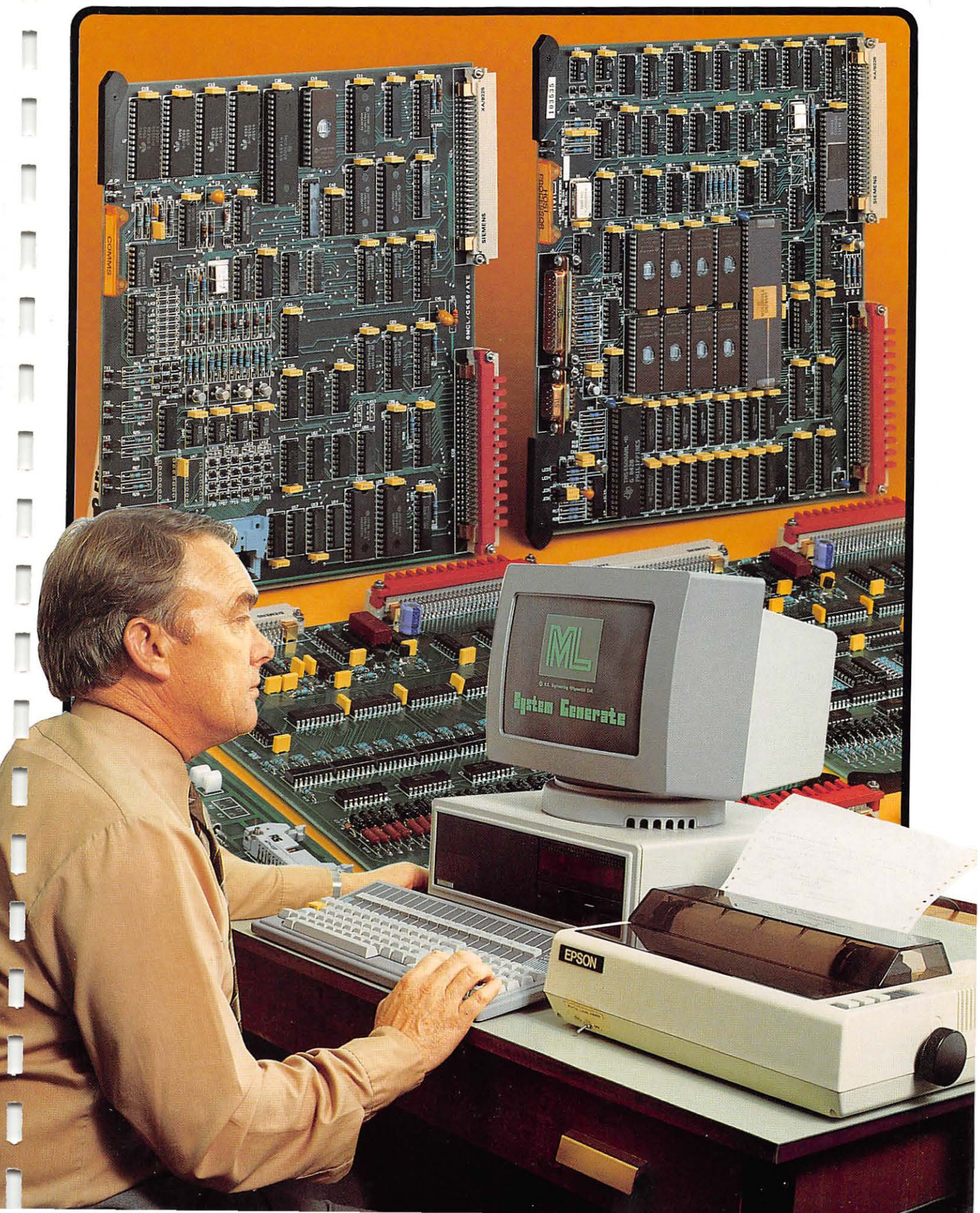
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TEML 40

INTELLIGENT DATA TRANSMISSION



TEML40

- Economic Secure TDM Data Transmission
- 16-Bit Microprocessor for flexible System Control and Data Processing.
- Fully Reconfigurable.
- Microprocessor Control of Inputs and Outputs to Cover Applications of Panel Processing, Button Processing, Train Describers, etc.
- High Capacity and High Speed Operation.
- Point-to-point and Multi-Station Operation.
- Modular Hardware and Software.
- Robust Design for Harsh Environments.

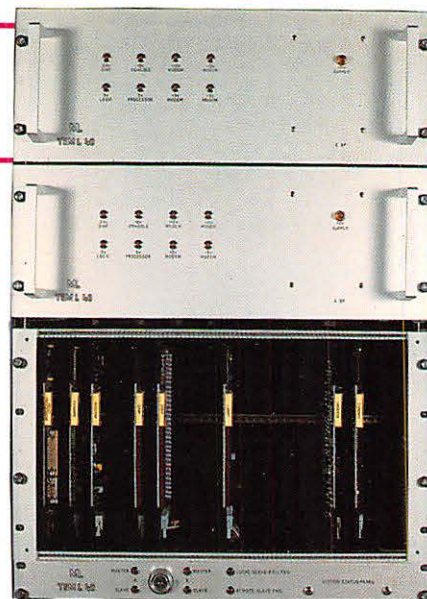
The primary function of TEML40 is to provide secure and reliable data transmission. However, because of the incorporation of a powerful data processing capability all its inputs, outputs and communication links can be software controlled in a very flexible manner.

Both Hardware and Software of the TEML40 System are designed on a modular basis and many system variations can be provided.

A TEML40 System, normally comprising a TEML40 unit at each end of a link, can accept up to 2^{10} independent inputs and provide up to 2^{10} independent outputs. Other cards provide serial link capability – 20mA loop, RS232C and CCITT V23.

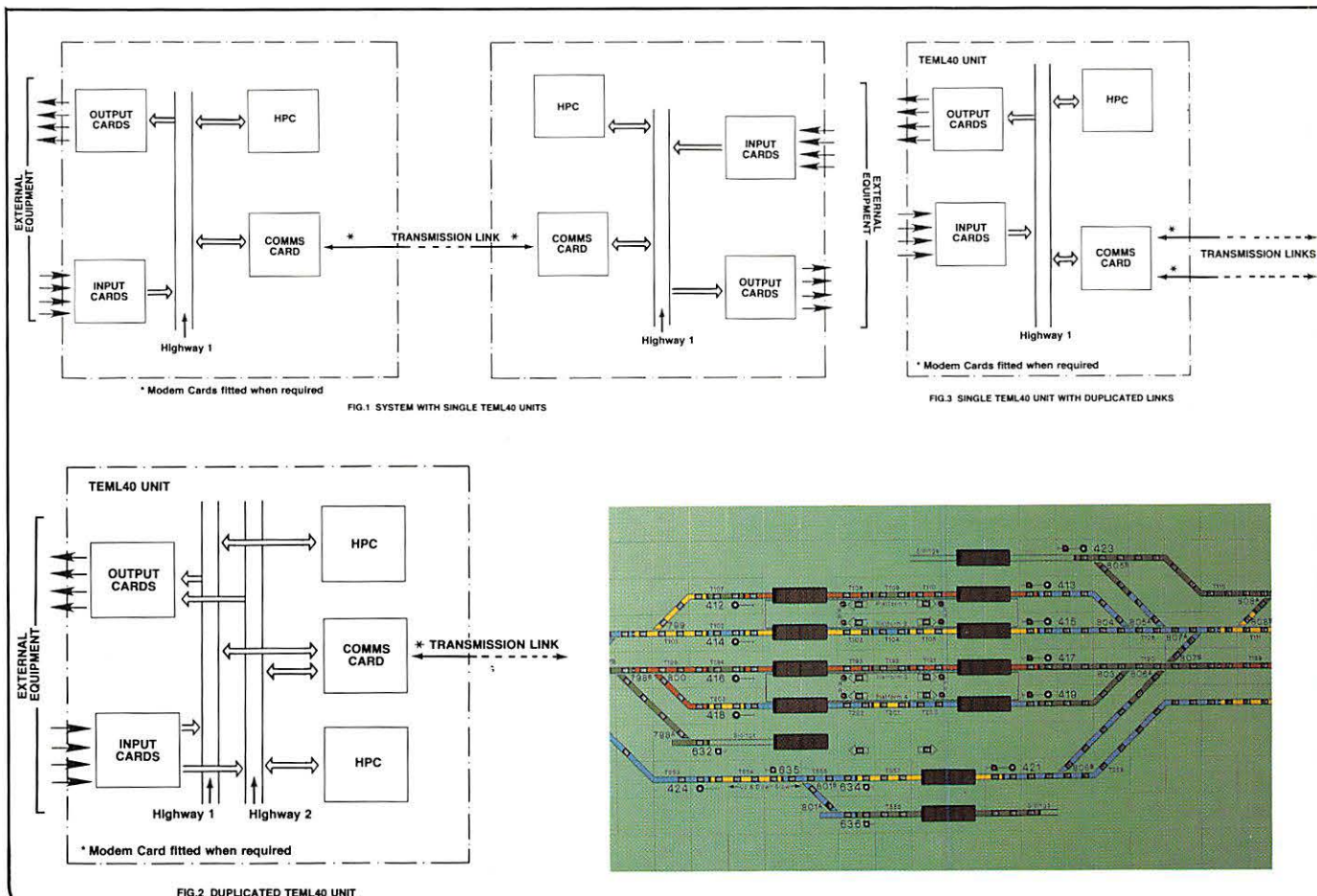
A suite of programs called 'SYSTEM GENERATE' are available which when run on a desktop personal computer enables the user to initially configure a TEML40 system and reconfigure it should subsequent changes be made to a scheme. The allocation of inputs and outputs, serial communication links and system hardware configurations can be defined and redefined as necessary.

In applications where the highest availability is of paramount importance, a TEML40 system can be duplicated. In a single system, Fig 1, one card containing a 16-bit microprocessor (Host Processor Card) in each TEML40 unit provides all main microprocessor control. A second card (Communications Card) supervises the communications. Figs 2, and 3 depict



TEML40 systems with (a) duplicated Host Processor Cards (HPCs) and a single link, and (b) single HPC with duplicated link. An arrangement with duplicated HPCs and duplicated Communications Cards is also possible as standard. In each case the Comms Card can drive other serial devices or further TEML40 units.

Because of the processing capability of the Host Processor Card, a TEML40 unit can be used in applications where a large number of serial ports are needed. In such cases, additional Communications Cards are fitted, to provide up to 16 ports, with Modems if required. TEML40 Modem Cards or proprietary modems can be used; TEML40 Modem Cards have the advantage that they are fitted in the unit.



INTELLIGENT DATA TRANSMISSION

TEML40 UNIT

Each unit is housed in a 6U, 84E wide rack, containing 16 card slots. A unit can comprise up to three racks as determined by the number of inputs and outputs. Two slots are dedicated to Host Processor Cards, the remainder can hold any other type of TEML40 card. Inter-card signals and dc supplies for the cards are carried on a multi-layer backplane. This backplane has 32 DIN connectors arranged in vertical pairs into which the TEML40 cards mate (two connectors per card). The backplane has two highways, thereby accommodating both single and duplicated configurations; one highway for each HPC.

Where additional racks are required, a TX Buffer Card which connects to both highways is linked to RX Buffer Cards, fitted in the HPC slots in the subsequent rack, via twisted pair ribbon cable. In some applications, unpopulated Buffer Cards are sufficient.

HOST PROCESSOR CARD

This card forms the heart of any TEML40 unit controlling all operations. When two HPCs are fitted (duplicated unit), one acts as the 'master' and the other as 'slave'. Both cards receive the same information so that in the event of a failure, the 'slave' can immediately assume control, in doing so it becomes the 'master'. In addition to a 68000 16-bit microprocessor, this card contains sixteen 64K $\times$ 1-bit dynamic random access memory (DRAM) chips for storing working parameters, input/output states, etc. A DRAM controller provides address and selected latches, memory refresh, timing and arbitration controls. The system programs and data are held in up to 128K $\times$ 16-bits of electrically programmable read-only memory (EPROM) comprising eight 32K $\times$ 8-bit EPROM chips arranged in four pairs. The data is reconfigurable using SYSTEM GENERATE. The card communicates with the other system cards via one of the two highways on the backplane. A DUART provides two additional ports. The area of memory (256 $\times$ 4-bits) where error codes are stored is overlaid with electrically erasable PROM (EEPROM), and such codes are stored in the EEPROM if and when the microprocessor detects a fault condition. The codes can be read using a special display unit, even after the card is removed from the system.

COMMUNICATIONS CARD

This card controls the flow of messages between (a) two or more TEML40 units, and (b) TEML40 units and peripheral equipment or other systems, eg Train Describers. Information for transmission is received from the HPC via the backplane. Messages are stored in dual port RAM until the on-board microprocessor is ready to send

them. The card also routes messages which are not intended for the HPC. Four communication ports are available on each card, they can be selected, on-board, to operate over the following types of link:

Ports 1 and 2 — 20mA current loop or modem

Ports 3 and 4 — 20mA current loop or RS232C

Each port is brought out to a connector accessible from the front of the card.

Where duplicated links are used, the Comms Card uses a test mode for testing the standby link.

MODEM CARD

Used where communication links are over 300m (up to that 20mA current loop is normally suitable). Modem Cards are connected to their associated Comms Card by a short ribbon cable. The card can be used in either 2- or 4-wire mode, selected by links on the card. The main component on the card is a single chip asynchronous frequency shift keying modem. This device is capable of operating in several modes, the most common being CCITT V23, ie 1200 baud, 4-wire. If other modes are required, contact ML Engineering for details; selection must be made during manufacture.

DIGITAL INPUT CARD

Accepts up to 32 independent inputs from voltage-free contacts. A change-of-state at any input generates an interrupt to the HPC which initiates an interrupt routine. The purpose of this routine is to identify the card responsible for the interrupt thus enabling the HPC to read that card. Input lines are filtered, optically-isolated with surge and reverse voltage protection. A hardware de-bounce circuit is provided for each input. Each input also supplies a contact wetting current of approximately 5mA, this being supplied from an external power supply fed to the card via the same cable as the input. The inputs are connected to the card using ribbon type cable via an IDC connector accessible from the front. The card has two DIN 41612 type connectors on the rear, enabling it to connect to both backplane highways and hence both HPCs in a duplicated system. An address header allows each card to be allocated a unique address.

OUTPUT CARDS

There are three types of output card, each providing up to 32 independent outputs. The outputs are optically-isolated and latched so that they remain in the last state until instructed by the HPC, via the backplane, to change state. Each type of card has two DIN-type connectors on the rear to connect it to the two backplane highways and leave both HPCs in a duplicated system. A unique address is selected

for each card on its 16-way address header. Outputs are taken from a card via an IDC connector and ribbon-type cable. The three types of card are as follows:

Relay Output (ROUT) Card —

Each output is in the form of an open-collector driver suitable for energising a 50V dc BR930-type relay, to a maximum of 4W. Power supply constraints may, however, limit the number of outputs that can be energised at any instant. The switching voltage of 50V dc is fed to the card via its output cable.

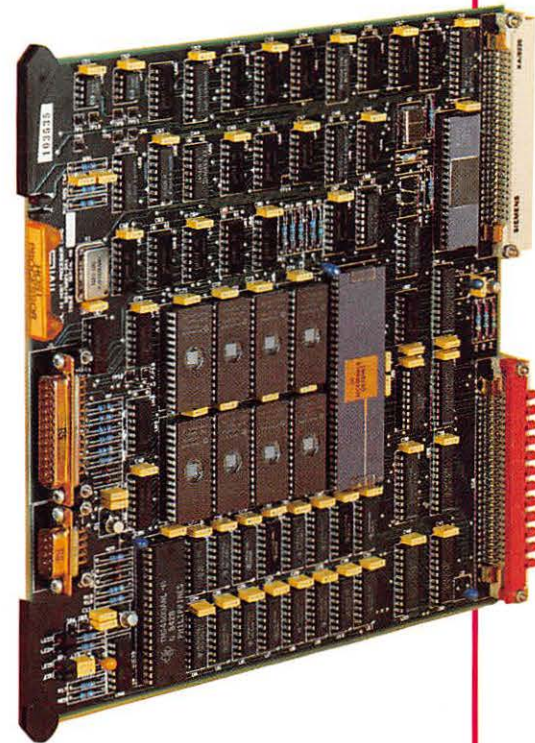
LED Driver Card (LEDDC) —

Each output is capable of driving 10 light emitting diodes (LEDs), although power supply constraints limit this to a maximum of 128 LEDs driven from one card at any instant. The 5V dc LED supply is routed via the output cable.

Lamp Driver Card (LDC) —

Each output is able to drive one 18V dc 1.2W lamp.

The LEDDC and LDC have three output states, these being off, 'on steady' and 'on flashing'. The flash rate for all cards in a system is controlled by a System Clock Card, this ensuring synchronisation of indications.



SYSTEM CLOCK CARD

Provides the flash rate for LED and Lamp Driver Cards, thus ensuring that all LED and lamp indications flash in synchronism.

SYSTEM RESET CONTROLLER

An integral part of each power supply rack, this card resets the system if it detects a dip or a break in the mains supply which could affect system operation.

POWER SUPPLIES

Power Supply Units (PSUs) are housed in 84E wide racks; normally two racks, housing identical units, are used for each TEMPL40 Unit connected so that if one PSU fails, the supply is maintained by the other. PSUs providing the following separate supplies are available:

- +5V dc for TEMPL40 card logic;
- +5V dc for the Host Processor Card;
- ±5V dc for the Modem Cards;
- ±12V dc for the optional RS232C interface on the Comms Card;
- +12v dc for the 20mA current loop on the HPC and Comms Cards.

SYSTEM INDICATIONS AND MAINTENANCE AIDS

To assist technicians to identify faults, several indications are provided. Each input/output on DINP, ROUT, LEDC and LEDDC cards has a status indication viewable from the front. HPCs and Comms Cards have processor active and serial link channel active indicators for each port. Similarly

the Modem Card has indicators for the data link to/from the Comms Card and for the transmission line. All of these types of card have a 'power on' indicator. Indicators are provided for each power supply unit on the front panel of the PSU rack.

Each card is capable of being removed/fitted to the rack with the power applied.

A Status Panel is available for duplicated units, this provides the following controls and indications:

- Centrally biased, 2-way switch enable manual switching between master and slave HPC;
- Master and Slave status LEDs;
- Local and remote slave PSU indicators.

A Field Test Unit is available for testing TEMPL40 cards.

LABELLING/SECURITY

Racks are given meaningful identities, card positions are numbered and each card has an 'identifying' label.

All card positions are mechanically polarised to ensure that the correct card

type only fits in the correct position.

To increase security, the backplane carries system identity links for each HPC which are selected after the system has been configured; the code set on these links is also contained in each data EPROM. The codes are compared at power-up and must be the same for the unit to become active.

All printed circuit cards are fitted with insertion/extraction devices; these not only make removal and insertion easier, but provide more reliable contact and immunity from vibrations.

SYSTEM GENERATE (SG)

A suite of programs, implemented on an Olivetti M24 personal desk-top computer, enables the user to initially configure the system and reconfigure it if changes are subsequently made. Other hardware required for SG is a 'parallel' printer and 'serial' EPROM Programmer. The control tables generated by SG can be displayed on the monitor, printed or directly blown in EPROM. System Generate is extremely sophisticated, but easy to use.

SPECIFICATION

Inputs: DINP Card -Up to 32 independent inputs from voltage-free contacts. 24V dc 5mA contact wetting current (50V dc version also available).

Outputs: ROUT Card -Up to 32 outputs, each output is suitable for energising a 50V dc BR930-style relay, to a maximum of 4w, although power supply constraints may limit the number of energised outputs at any instant. (50V dc supplied from external PSU).

LED Driver Card -Up to 32 outputs, each output can drive up to 10 LEDs. (External 5V power supply required which can limit the total number of LEDs driven from one card to 128).

Lamp Driver Card -Up to 32 outputs, each output can drive one 18V 1.2W lamp (18V supplied from external PSU).

Communications: <300m 20mA current loop or RS232C (optional). >300m modem.
Modem — (preferred) output CCITT V23 (other modes are possible, contact ML Engineering (Plymouth) Ltd for details).

Power Consumption:	HPC	7.5W
	Comms Cards	5.0W
	Modem Card	2.0W
	DINP Card	0.2W
	ROUT Card	0.2W
	LED Driver Card	0.3W
	Lamp Driver Card	0.3W

Physical: Temperature Range 0°C to +60°C, complying with BR 967 Cat A & B

Dimensions -Printed Circuit Cards
245mm high × 230mm deep (including connectors & handles)
Rack 265mm high × 485mm wide × 365mm deep

Weights -HPC 455g
Comms Card 370g
Modem Card 285g
DINP Card 330g
ROUT Card 320g
LED Driver Card 305g
Lamp Driver Card 355g
Rack 3590g

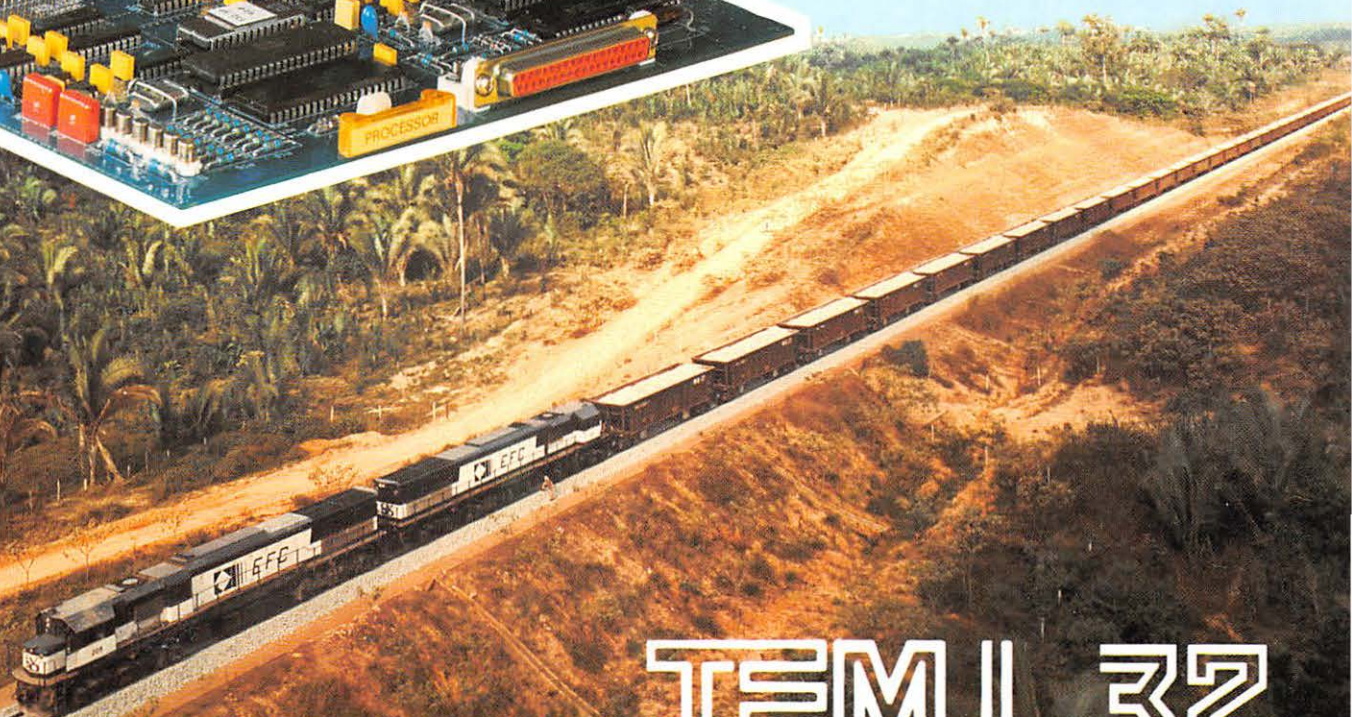
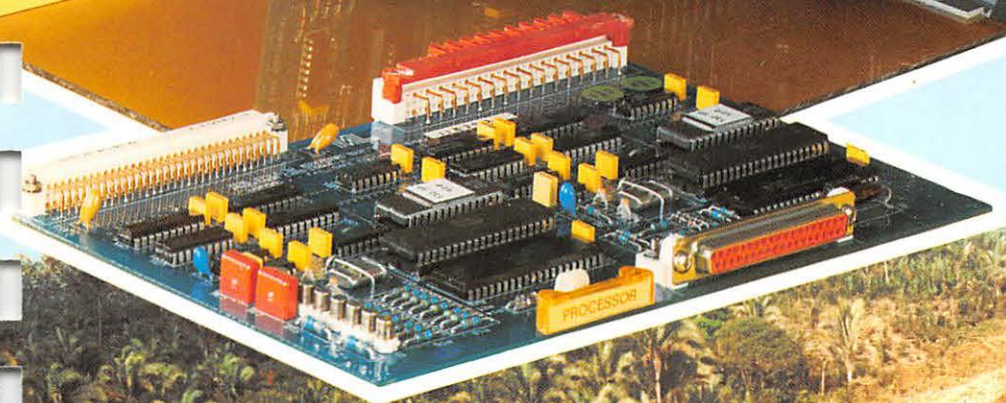
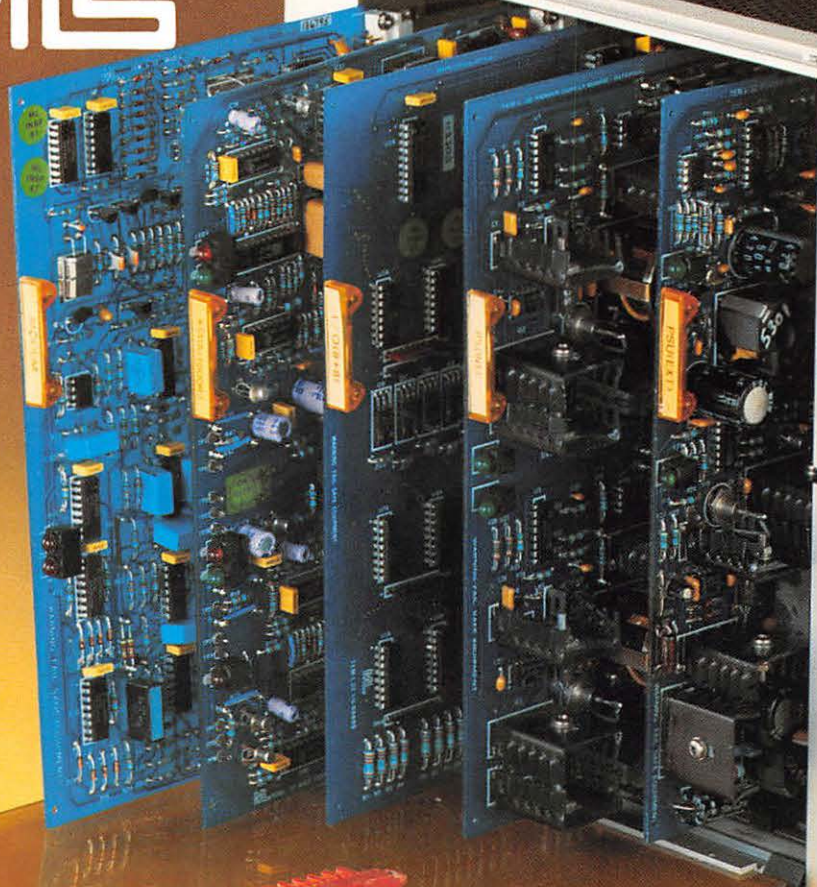


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ML



TEML 32
VITAL DATA TRANSMISSION

TEML 32

- Economical Fail-Safe Signalling via radio, cable or carrier.
- Microprocessor based for safety and flexibility.
- Capacity of 24 bits in each direction.
- Transmits Axle Counter Data.
- Point-to-Point or Multi-Station Operation.
- High Speed Time Division Multiplexing.
- Robust Design for Harsh Interference Environments.
- Modular Hardware and Software.

GENERAL FEATURES

TEML 32 is basically a Point-to-Point fail-safe data transmission system capable of transmitting up to 24 states in each direction over a standard audio frequency channel. Inputs generally take the form of voltage-free contacts and outputs are available to directly drive safety relays.

Transmission may be via cable, overhead line, carrier systems or radio as the system basically requires a 2- or 4-wire audio frequency 600 ohm channel.

The TEML 32 transmitter/receiver units operate in an asynchronous time division multiplex mode responding only to discrete, highly secure digital addresses. Whilst the system is basically point-to-point, it may be operated in multistation mode with a central office unit controlling programmed polling of the outstation units.

TEML 32 was developed primarily for fail-safe Railway Signalling applications, providing the link between signalling relays and their controlling contacts, but may be used for many other vital transmission applications.

It will operate reliably in the harsh electrical interference environment of a typical railway signalling relay room.

TYPICAL RAILWAY SIGNALLING APPLICATION

A railway system is often characterised by geographical configurations which feature long sections of single line between areas of points and crossings. These sections of single line may be made up of one or more block sections and occupation of a block section can be detected in several ways, such as:

- a) Continuous track circuits
- b) Entrance/exit track circuits plus last vehicle detectors
- c) Axle Counters

In each case a number of fail-safe controls and indications must be passed from one end of the block section to the other. This is where TEML 32 can provide an economical means of transmitting such digital data over a single audio channel (for example a line pair or a channel within a carrier or radio system).

TEML 32 can transmit up to 24 contact states in each direction, alternatively it can accommodate an axle count plus up to 16 contact states in each direction. Inputs are taken directly from voltage-free contacts and corresponding outputs are available, at a nominal 24 volt 60 mA each, to drive safety type signalling relays.

A special interface card is provided to interconnect to a conventional axle counter.

With the use of appropriate filters it is possible to multiplex speech with the TEML 32 digital data, e.g. speech in the band 300 Hz to 2400 Hz can be provided with the TEML 32 operating in the range 2700 Hz to 3060 Hz.



AXLE COUNTER OPTION

The TEML 32 units have been designed to cater for the transmission and reception of axle counter information from a Standard Elektrik Lorenz (SEL) Type AZL70 Axle Counter System. An SEL AZL70 System normally comprises an evaluator unit at one end of each block section and axle detectors at both ends. The SEL AZL70 trackside equipment consists of two wheel detectors on one rail, together with a trackside amplifier. The amplifier detects and processes signals from the detectors into a form suitable for transmission to the evaluator unit. TEML 32 with its axle counter interface cards enables the traditional cable-based transmission line, from the remote end of the section, to be replaced with a radio link.

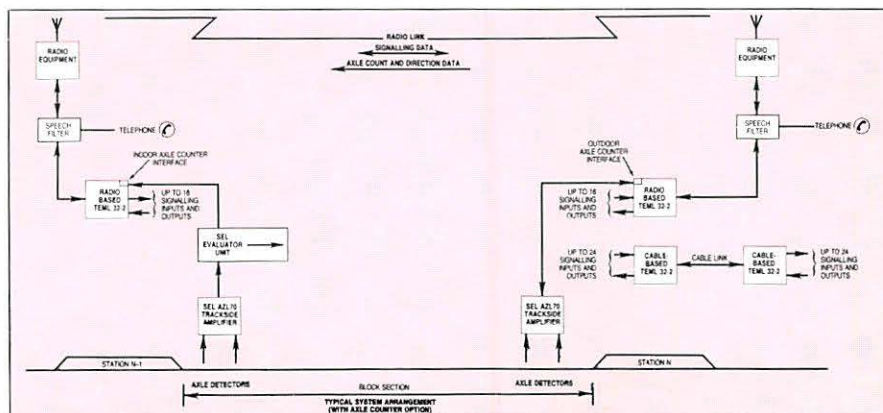


Fig 1. depicts a typical block section using two TEML 32 systems for the transfer of data via a radio link.

VITAL DATA TRANSMISSION

FAIL-SAFE FEATURES

TEML 32 uses a duplicated microprocessor system to provide an extremely high level of security giving the all important fail-safe features. Both microprocessors perform the complete range of unit functions and each one cross checks, at regular intervals, its internal states with the other. These checks include input/output lines and message data.

In addition to these cross checks, each microprocessor performs a series of self-checks to ensure correct working of its RAM, EPROM and output isolating circuits, etc. All outputs are controlled by both microprocessors. An indication of all outputs, i.e. the modem output and the signalling outputs, is fed back to both microprocessors for comparison with the requested outputs.

The dual microprocessors fitted on the

Axle Counter Interface Card (Outdoor) perform self-check routines and if an error is detected it is flagged to the microprocessor(s) on the Microprocessor card.

If either microprocessor detects an error, or a check fails, then it shuts down the TEML 32 Unit by causing an on-board fuse in the +5V (safe) power supply line to rupture. This results in the isolation of (a) the output lines by removing power from the output stages and (b) the modem output.

During the shutdown process, the microprocessors run fault-finding routines and enter codes into a non-volatile memory, which can be accessed later by maintenance staff using a special reader.

Further security is achieved by using special techniques for the transmission of the data message. These techniques include:

- ☐ Fixed message length;
- ☐ Manchester II coding to give exceptionally high protection against burst error noise — particularly prevalent on radio links;
- ☐ Message forms a truncated hamming code sequence;
- ☐ Data transmission is frequency shift-keyed (FSK) modulated using frequencies of 3060 Hz and 2700 Hz — interference outside this narrow band is greatly attenuated.
- ☐ Outputs remain energised until next message received. If message is corrupted, a re-transmission is requested. If after a number of attempts, the message is still corrupt, the outputs are turned off. When communication is re-established, the outputs are turned on again, reflecting the current state of the inputs at the other end of the link. Any axle counts are stored.

TEML 32 RACK

Contains up to seven printed cards mounted vertically in a European-standard 42E rack, 6U high. Each card has two, card-mounted, 64-way DIN plugs; the upper plug mating with a socket mounted to the unit backplane, and the lower being used for external input and output connections. The lower plugs and sockets are fitted with mechanical polarising devices which prevent a card type being plugged into the wrong position. Line isolating transformers, surge protection devices and other protection devices are fitted on the inside of the rear of the unit. External connections to the unit are made via PYE connectors on the rear of the unit.

MICROPROCESSOR CARD

This card forms the heart of a TEML 32 unit — all control and unit operation originates from it. The card comprises a duplicated configuration in which two identical microprocessor systems run with identical software. Each system receives the same data and regularly performs cross checks on its internal states with that of the other. Each microprocessor has 128 × 8-bit on-chip random access memory (RAM), but an additional 2K × 8-bits of RAM can be added to the card if required. The system programme is held in a 8K × 8-bit, electrically programmable, read only memory (EPROM).

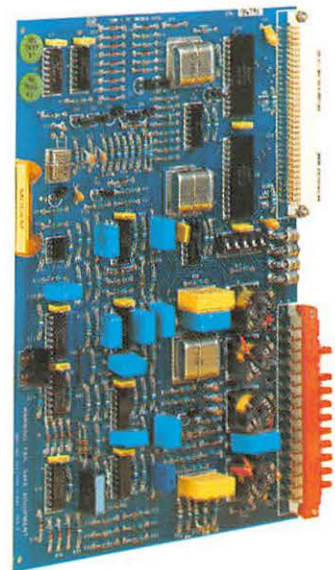
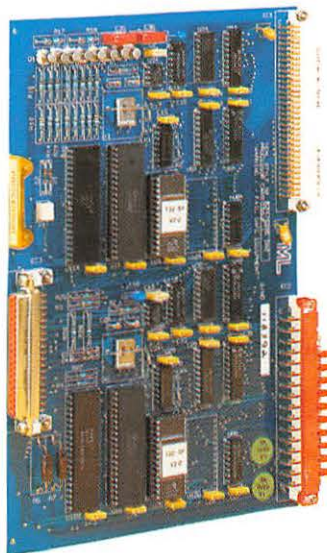
The card also contains two power supply supervisors which reset both systems at power-up or during temporary 'dips' in the +5V supply. This ensures that the two systems do not operate in an unpredictable manner; the outputs from both supervisors are linked to ensure a reset to both microprocessor

systems, even if only one supervisor detects a power-up or 'dip'. A fuse-blowing circuit on the microprocessor is fundamental to the system. In the event of detection of an unsafe condition, power is removed from the outputs by activating a fast shut down transistor and blowing a fuse in the +5V (safe) line such that even in the event of a subsequent unit reset, the blown fuse inhibits operation of the unit.

MODEM CARD

Provides the interface between the microprocessor card and the communication link. It converts the parallel digital data from the microprocessor card into a serial frequency shift-keyed (FSK) signal of 3060 Hz (logical 1 or mark) and 2700 Hz (logical 0 or space) and vice versa. The card operates in half-duplex mode over a 4-wire link at 300 baud.

Characteristic impedance is 600 ohms. The transmit level is adjustable in 1dB steps from 0dBm to -31dBm, using a card-mounted switch. The sensitivity of the receiver can be link selected to -30dBm, -35dBm or -40dBm. Two-wire operation using hybrid circuits is also possible.



INPUT/OUTPUT CARD

This card interfaces the TEML 32 Unit with the signalling equipment. Two versions of the card are available — one with four inputs and four outputs, and the other with eight inputs and eight outputs. Each input/output is via an opto-isolator, these prevent transient voltages from the external equipment affecting the operation of the Microprocessor Card.

AXLE COUNTER INTERFACE CARDS

Fitted only when the axle counter option is required, there are two versions — an 'Outdoor' and an 'Indoor' card. The Outdoor version is fitted in the TEML 32 Unit at the end of the track section which is remote from the axle counter evaluator unit and interfaces with an SEL AZL70 Trackside Amplifier, and hence the detector unit. The card decodes the frequency signals from the amplifier to provide axle counter and direction of travel information which is passed to the Microprocessor Card for transmission. This card also provides the power supply, via the signal lines, for the SEL amplifier.

The 'Indoor' card accepts the axle count and direction of travel from its associated Microprocessor Card and outputs the correct number of pulses in the right phase to an SEL evaluator unit.

POWER SUPPLY CARD (External)

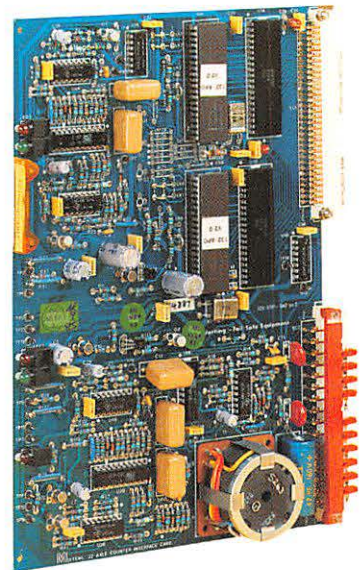
This card, which fits the TEML 32 Unit, provides the following supplies from a nominal +24V d.c. input:

- +10V d.c. for Modem Card.
- +(62 to 83)V for an SEL AZL70 trackside amplifier, via the Axle Counter Interface Card (outdoor).
- +24V d.c. (safe) for the Input/Output Cards (this supply is 'safe' in that it is inhibited under control of the microprocessor card, when an operating error is detected).

POWER SUPPLY CARD (Internal)

This card, fitted in the TEML 32 Unit, provides the following supplies from a nominal +24V d.c. input:

- Two independent +5V d.c. supplies for the duplicated microprocessor system.
- Two independent +10V d.c. supplies for the duplicated microprocessor interface system on the Axle Counter Interface Cards.



SPECIFICATION

Signalling Inputs:	Voltage-free contacts, fed from an isolated d.c. supply which is provided by the external PSU card. Relay contacts are fed with 20 mA 'wetting' current.
Signalling Outputs:	Open-collector transistors sinking a d.c. current at 24V d.c. (from the external PSU card). Each output can supply a maximum of 60 mA.
Axle Counter Interface Option:	Standard Elektrik Lorenz AZL70 Axle Counter.
Communications Link:	
RX and TX Frequencies	2700 HZ (Logical 0) $\pm$ 10 Hz 3060 HZ (Logical 1) $\pm$ 10 Hz
Data Rate	300 baud, other rates available.
Scan Time (secs)	1.55 (without retransmissions)
Characteristic Impedance	600 ohms.
Modem Output Level	Selectable from 0dBm to -31dBm in 1dB steps.
Modem Input Level	Selectable at -30dBm, -35dBm, or -40dBm.
Radio	Please contact ML Engineering for details.
Power Requirements:	+24V d.c. nominal (20 to 30V) @ 4A Current consumption dependent on output load.
Physical Dimensions:	PCBs 234mm high $\times$ 170mm deep Rack 265mm high $\times$ 285mm long $\times$ 290mm deep (including mounting flanges and excluding connectors).
Weights:	Microprocessor Card 280 grams Modem Card 315 grams Input/Output Card (4+4) 195 grams Input/Output Card (8+8) 215 grams Axle Counter Interface Card (Outdoor) 380 grams Axle Counter Interface Card (Indoor) 215 grams Power Supply Card (External) 635 grams Power Supply Card (Internal) 565 grams Rack (no cards) 4725 grams
Environmental:	Operating temperature range 0° to +55°C Relative Humidity: 95% non-condensing.



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TEM L Style 30 Radio Interface For Block Instruments

Radio Link System for Single Line Signalling Installations

In many parts of the world the safety of trains on single line railways is ensured using electro-mechanical machines to release only one 'token' or authority to drive over the line, at a time. The principal disadvantage of token machines lies in the necessity for a direct electrical line connection between the two ends of a single track section, as this represents a considerable maintenance burden, particularly where the line wires are prone to damage by bad weather or vandalism.

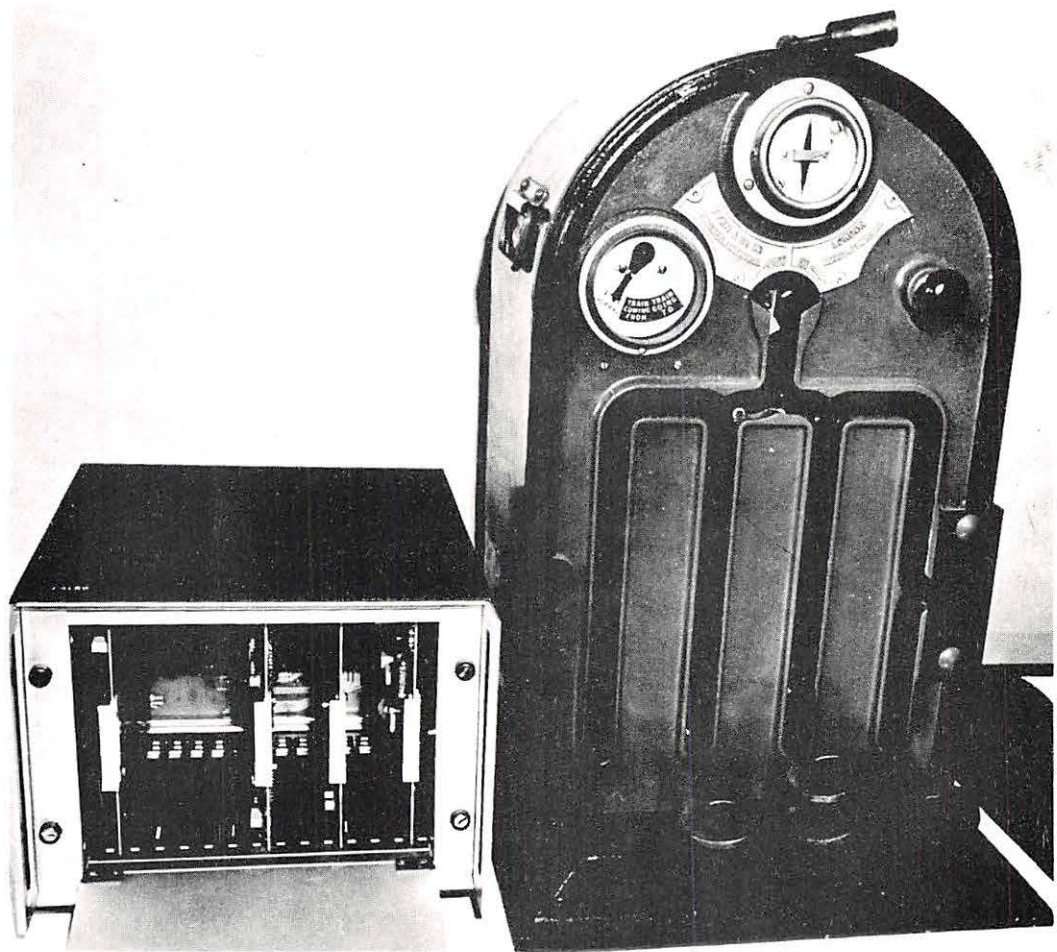
The increasing existence of radio installations for communication with train crew and maintenance staff makes it attractive to propose the use of a radio network for the transmission of bell codes and release signals between block instruments.

British Rail's Research & Development Division has developed a system which enables a vhf radio network to be used with token signalling installations which requires little modification and retains full compatibility with speech transmission and selective calling equipment.

Principles of Operation

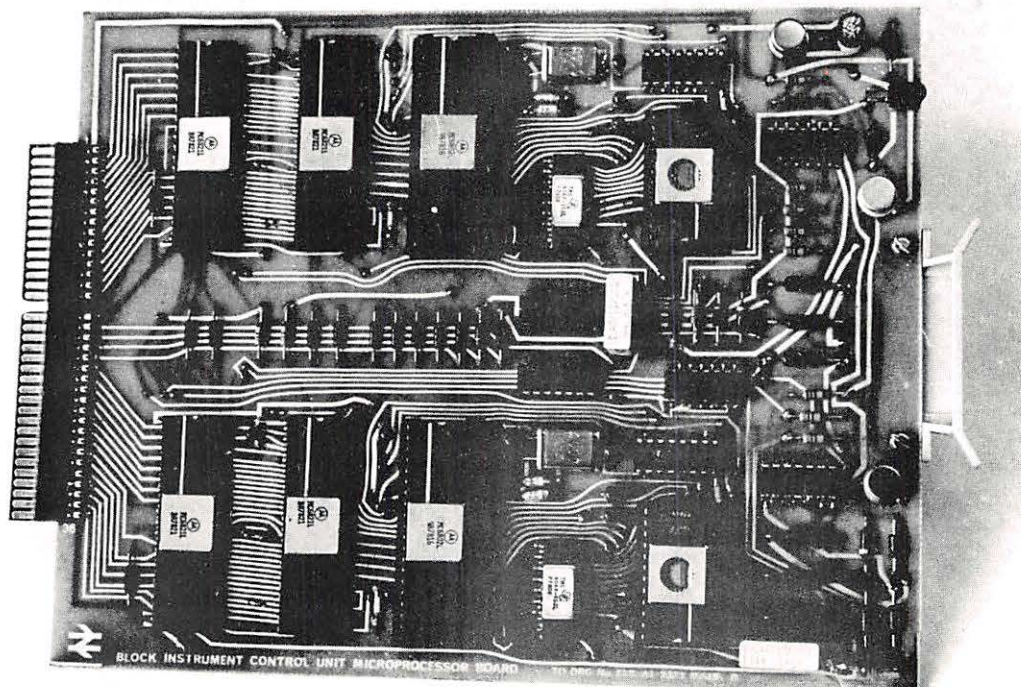
The security afforded by single line token equipment lies partly in the bell codes and procedures used by the signalmen but mainly in the electrical and mechanical integrity of the instruments which are designed so that only one token may be released for use at any one time. The vital information transmitted from one instrument to the other is the polarity of the electric current which flows when the signalman operates the push-button or plunger that operates the bell on the distant instrument. The task to be performed by a radio control unit is mainly to transmit polarity and bell code information from one site to the next with the high degree of security demanded for railway signalling.

(Fig. 1)
Control Unit module
standing alongside
a typical single
line block token
instrument.



The Control Unit consists of four circuit boards housed in a compact free standing case (Fig. 1). The circuit boards carry power supplies, a power disabling device, token instrument interface circuitry, a modulator-demodulator, and a duplicated microcomputer (Fig. 2) which performs all the logic functions associated with the correct and safe operation of the unit. The power disabling device and 'redundancy management' circuitry associated with the microcomputer are designed to ensure failure of the equipment to a safe state in the event of an internal fault.

(Fig. 2)
Block Instrument
Control Unit
Microprocessor Board.
Identical
microprocessor systems
on each half of the
board ensure the
safety levels required
for railway signalling.



(Fig. 3)
Single line section
with radio linked
token signalling
equipment.

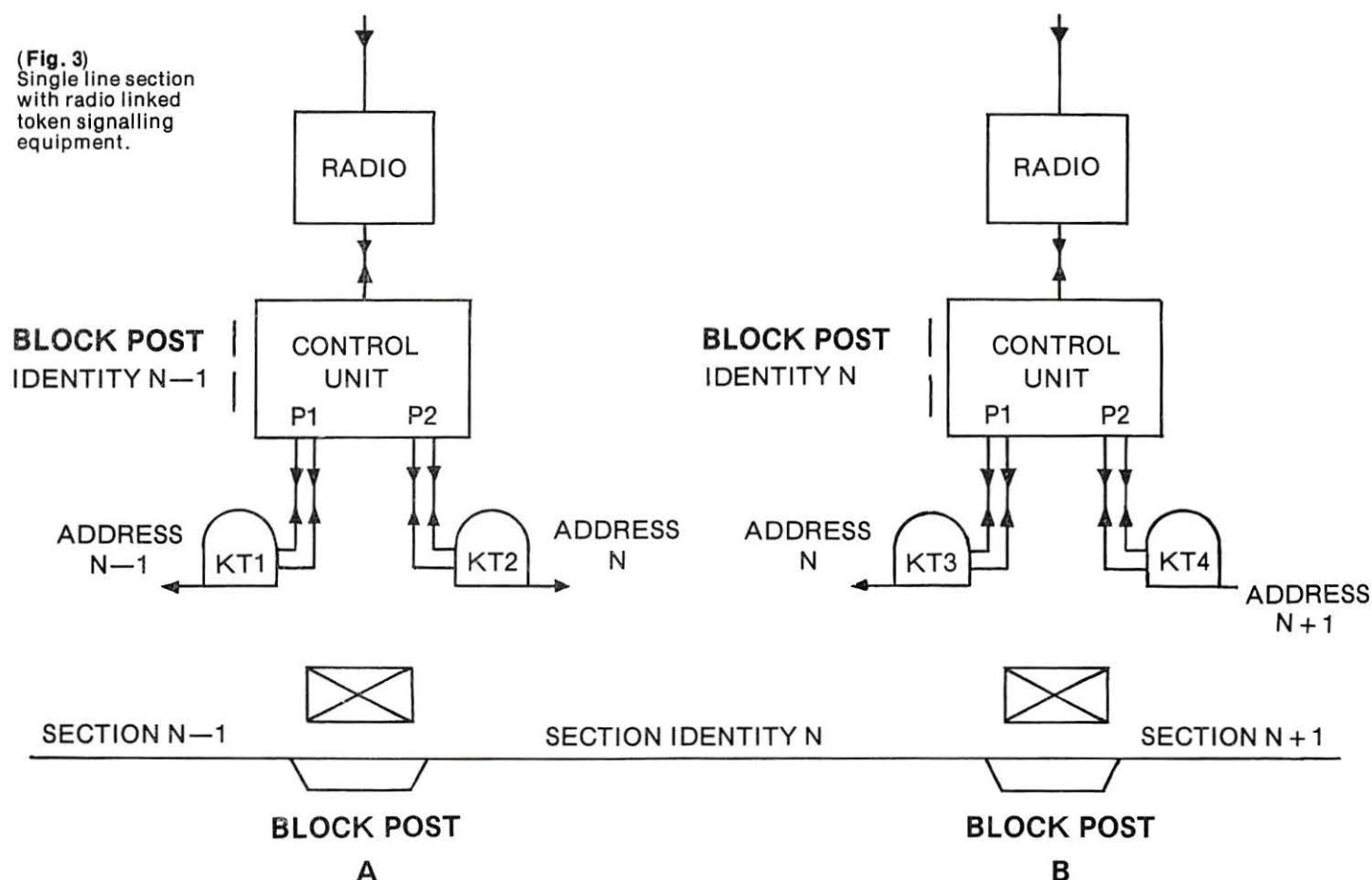


Fig. 3 shows a section of single track between two block posts A and B. Each post is provided with a radio transmitter and receiver, two key token instruments, a control unit, and has a numerical identity coded into its fixed wiring. This code is read by the control unit and must be unique within the radio network. Each control unit has two pairs of connections to token instruments, P1 and P2, and the relationship between the block post identity and the address associated with each pair is defined in the diagram. It will be seen that the instruments at either end of a block section share the same address, which may be regarded as the identity of the block section.

In operation the signalman enters his bell code in the normal fashion, and a record of his action is formed within the control unit. When no further information has been entered for a short time the record is considered complete and is assembled into a coded message, together with the instrument address and information about the polarity. The message is transmitted as a frequency shift keyed (FSK) modulation of an audio frequency carrier, and is subsequently received at all other block stations. Only the relevant signal box will recognise the message address and reproduce the bell code with the correct polarity at the appropriate instrument. All other signal boxes will ignore the message.

A control unit can operate its two block instruments completely independently of each other. Message transmissions are typically very short, and are able to take advantage of gaps in voice transmissions. Strategies are applied to minimise the risk of loss of transmission due to conflicting use of the radio network.

TEM L Style 30

Radio Interface For Block Instruments

Radio System Requirements

The equipment is suitable for use with any voice grade radio network capable of satisfying modest group delay distortion requirements and providing adequate signal to noise performance for data transmissions. In many cases the system can be added to an existing radio network. Small modifications to block post radio equipment are required to provide audio frequency connection to the control units, and modification of all mobile and portable units to prevent interruption of data transmissions is desirable.

Installation on British Railways

The system developed by British Rail Research has been installed at eight locations covering 103 miles of the Inverness-Wick route of British Rail's Scottish Region. The area is covered by a mid-band vhf radio system having a number of base stations linked by a uhf network to a control centre at Inverness.

Further Information

Further information can be obtained from M.L. Engineering (Plymouth) Ltd. who are licensed to manufacture and market the equipment on behalf of BRITISH RAILWAYS BOARD.

The data contained in this catalogue is as accurate and up to date as reasonably possible. Since it is the policy of the Company to be continually reviewing designs, it is possible that current equipment may vary slightly from that described.

M.L. Engineering (Plymouth) Limited

Electrical Division, Estover Close, Plymouth, PL6 7PU, England
Telephone: Plymouth (0752) 702525 Telex: 45662 Cables: ELECEMEL Plymouth





TEM L Style 20

Fail-safe frequency
division multiplex system



Typical wall mounted system configuration with power supply, transmitters, receivers and L.F. filters.

The M.L. frequency division multiplex system TEM L Style 20 provides the ability to transmit a multiplicity of simultaneous vital signals via a single line pair or audio channel.

Spurious operation does not occur even with "noisy" communication links.

The system was originally designed to meet the need for a railway signalling tokenless block system for operation over a radio link where the environment is potentially noisy.

If speech is required to be transmitted over the same circuit then 16 individual channels are available within the carrier frequency range 2,000 Hz. to 3,400 Hz., thus allowing up to 2,000 Hz. for speech. On the other hand, if speech is not required to be superimposed on the system, then 24 channels can be made available using the range 1,000 Hz. to 3,400 Hz.

The system operates on a frequency shift principle with both the carrier frequencies being detected independently and the frequency of carrier shift being detected to give a number of bits of information. In this way each channel

can transmit 1 out of 6 bits of information at any given time.

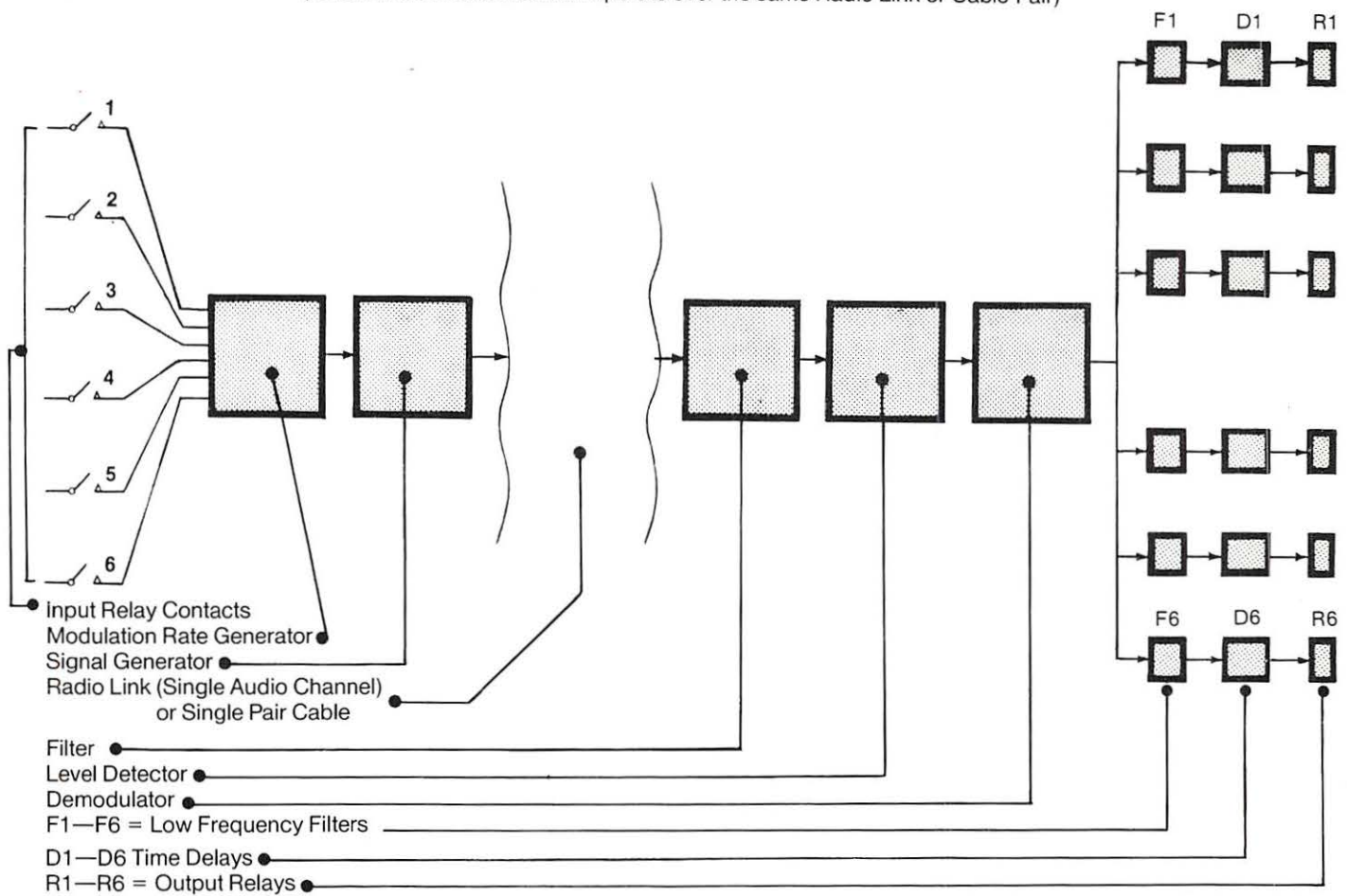
A block diagram of the basic system appears in figure 1. This shows a single "1 out of 6" information channel. Up to 24 such channels can be operated over the same line pair or radio channel at the same time.

A contact closure at the input to the transmitter causes a low frequency signal which modulates the frequency of the channel carrier oscillator. This signal is buffered and fed to the transmission link via an isolating transformer. At the receiving end the signal is fed to two tuned circuits each tuned to 1 of the 2 transmitter frequencies.

After level detection and de-modulation the output is fed to a bank of band pass filters which select the appropriate modulation rate and, following a pre-determined delay time, the relevant output relay is operated corresponding to the input contact which was closed at the transmitter.

Fig. 1 — Block Diagram of a Single TEM L Style 20
F.D.M. Channel

(Note: 24 such Channels can operate over the same Radio Link or Cable Pair)



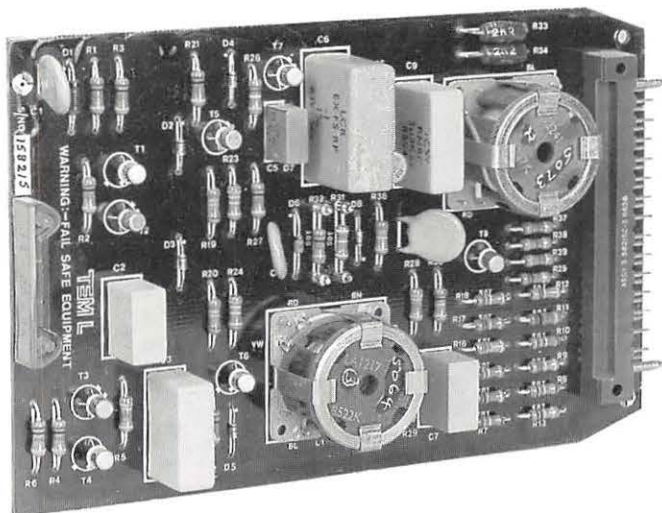
Applications

Typical applications of the TEM L style 20 system are:—

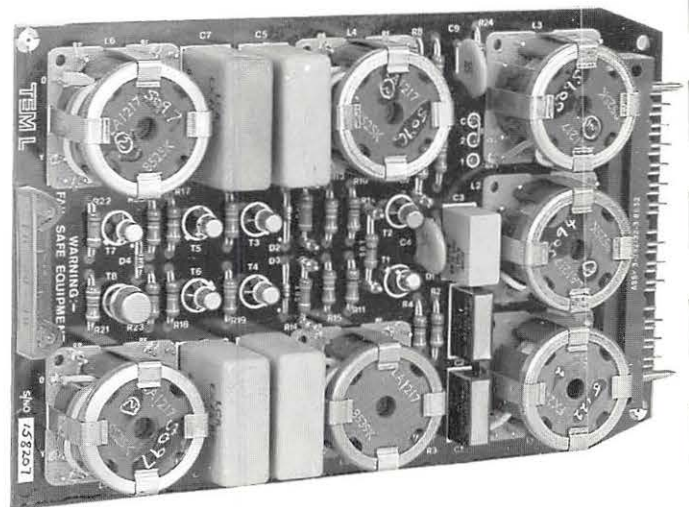
- * Tokenless railway block signalling system.
- * Transmission of safe controls for vital inter-locking circuits for railway signalling.
- * Transmission of safe inter-locking controls and indications for Industrial Control System, e.g. nuclear reactor, gas and petro-chemical plants, oil platforms etc.

System Modules

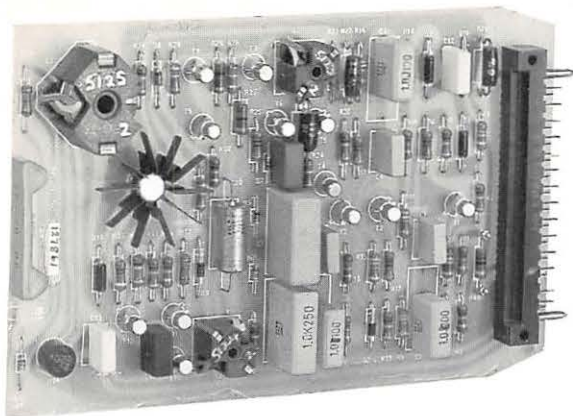
A system is made up of the following units:—



(a) A transmitter for each of the channels in use.



(b) A receiver for each of the channels in use.



(c) A low-frequency filter for each of the signals transmitted. This can mean a total of 6 times the number of receivers in the system.



(d) A power supply unit to supply power for a complete 19in rack.

(e) Speech filter printed circuit cards as required.

(f) 19in Mounting Racks.

MODULE SPECIFICATIONS

1. Transmitter

Power Supply Requirement
35 mA at 50 V.d.c.

Information
1 out of 6 bits

Modulation Frequencies
1.00 Hz
1.45 Hz
2.06 Hz
3.10 Hz
4.50 Hz
6.80 Hz

Modulation Frequency Accuracy
 $\pm 2\%$

Carrier frequency range allowing speech
0-1980 Hz. 16 channels
2000 Hz to 3400 Hz

Carrier frequency range 24 channels
1000 Hz to 3400 Hz

Carrier frequency accuracy
 ± 2 Hz

Temperature coefficient of frequency
Typically ± 50 p.p.m./ $^{\circ}\text{C}$

Output
May be preset up to +4 dBm

Inputs
Voltage free contacts
Closed contact less than 100 ohms
Open contact greater than 10 Mohms

Physical

The transmitter takes the form of a single printed circuit board 7"x 4 1/2", with a high quality two-part connector for plugging into a 19" rack.

2. Receiver

Power supply requirement
30 mA at 50 V.d.c.

Information range (modulation frequency)
d.c. to 7.5 Hz

Carrier channel capability
24 channels in range 1000 Hz to 3400 Hz

Frequency accuracy
 ± 2 Hz

Temperature coefficient of frequency
Typically ± 50 p.p.m./ $^{\circ}\text{C}$

Input level
Adjustable from -35 dBm to 0 dBm. Dynamic range 15 dB.

Output
50 v. peak/peak into 10 K. ohms

Physical

The receiver is constructed on a single plug-in p.c. board dimensions 7"x 4 1/2", with a high quality two-part connector for plugging into a 19" rack.

3. L.F. Filter

Power supply requirement
130 mA at 50 V.d.c.

Detection band width
 $\pm 12\%$ of nominal frequency, maximum.

Frequency range
1 Hz-6.8 Hz.

Temperature coefficient of frequency
 $\pm 0.1\%$ / $^{\circ}\text{C}$ max.

Operating time
Two to seven seconds dependent on channel frequency:—

Channel F6 (6.8 Hz)	— 2 seconds
Channel F5 (4.5 Hz)	— 2 seconds
Channel F4 (3.1 Hz)	— 2 seconds
Channel F3 (2.06 Hz)	— 3 seconds
Channel F2 (1.45 Hz)	— 4.5 seconds
Channel F1 (1.00 Hz)	— 7 seconds

Output
50 V.d.c. 2 watts with output indicator (L.E.D.)

Physical

Each filter is constructed on a single p.c. board dimension 7"x 4 1/2" with a high quality two-part connector for plugging into a 19" rack system.

4. General

Temperature range
-40 $^{\circ}\text{C}$ to + 70 $^{\circ}\text{C}$

Power supply requirement
50 V.A. max at 110 V $\pm 20\%$ 50 Hz or
50 V.A. max at 220 V $\pm 20\%$ 50 Hz

Mounting

The various system modules are mounted in a 5 1/4" high shelf arranged for 19" rack mounting (as illustrated on front cover). The input and output connections are by two strips of terminal connectors at the rear of the unit.

Speech channel

An extra filter card may be incorporated to cater for the use of the frequency range up to 2 K. Hz for speech.

Common mode protection

All input and output transformers are screened to eliminate effects of common mode surges.

resistors in this category are single layer wire wound types and glass based tin oxide types. The single wound capacitor with extended foil welded terminations has shown characteristics of failure to open circuit, short circuit, or parallel leakage only. Some tuned circuits especially when series connected, have fail-safe properties and often tuned circuits of this type are used in multiple cascade mode.

The route of Jordanian railway (Fig 2) where Style 20 was first used, lies in barren desert which is liable to washouts and duststorms. For this reason neither cable nor overhead line routes could be used between most of the stations. It was an ideal application therefore for UHF radio between stations to provide communication and for use as a bearer for vital signalling block release signals.

The method of operation of this railway is that each station (Fig 3) is manned and the distance between each section forms a single line block section. Safe sequential co-operative signalling between adjacent station signalmen is necessary before trains can be allowed into the block section. Two fdm channels, operating in opposite directions are used between adjacent stations to achieve this.

In each case the six data bits are allocated to the following functions:

- Emergency block release.
- Quiescent signal transmitted whilst block is clear.
- Train offered to adjacent section.
- Train entered section.
- Train left section.
- Train accepted from adjacent station.

There are sixteen radio block links on this scheme and each one has a different channel frequency from all others

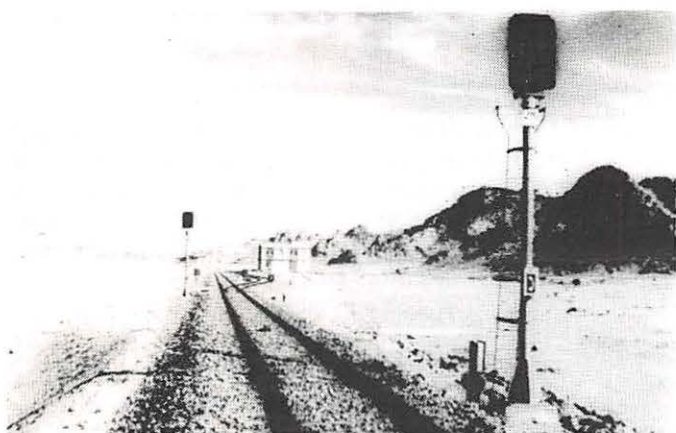


Fig 2. (above) A remote stretch of the Aqaba railway in Jordan. The radio mast can be seen in the background.

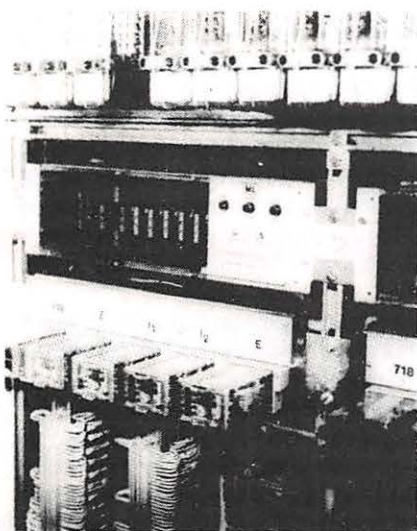


Fig 3. (left) A typical station installation of the telemetry equipment.

Fig 4. Printed circuit board of the fail-safe transmitter unit.

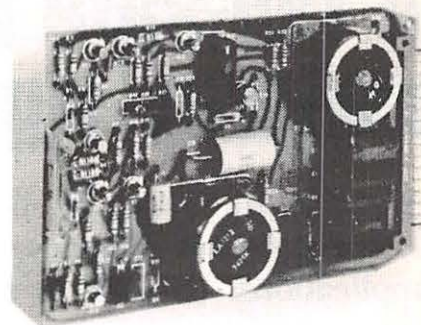
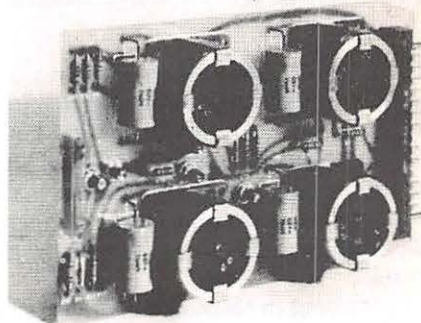


Fig 5. Printed circuit board of the receiver.



in that direction. This has been done to provide protection against freak 'skip over' radio transmission, although for these to occur it would be necessary for the radio frequency to drift as a different radio frequency is used for each transmission path.

In a very few areas where the radio paths are very difficult because of the terrain, the block signals are transmitted over cable, using identical equipment to that for the radio network except that the transmitted power level is raised slightly to cover cable losses.

The transmission equipment, known as Tem-L Style 20, uses printed circuit card (Figs 4 & 5) construction in 19 inch racking for ease of maintenance. A robust construction is used with single sided boards, a carefully spaced layout and high quality connectors. Where a surface leakage across the printed circuit copper tracks could set up a potentially dangerous condition, a shielding track is included between so that any leakage would always give a right side failure.

Since commissioning the system in Jordan, and introducing it to Glasgow's underground, a growing demand for the fail-safe qualities of the equipment has been identified outside the railway industry. Offshore oil platforms, both British and Norwegian, have adopted the system to provide safe remote control of tanker loading at sea from unmanned buoys up to 2 km away from the production platforms. A range of traction immune track circuits employing the same technology is also available.

John Rose, a graduate of Aston University, Birmingham, joined ML Engineering (Plymouth) Ltd in 1965 as a Development Engineer, with later appointments of Electrical Engineer, Chief Engineer and currently of Technical Manager. For most of his career he has been responsible for design and development of electronic and electro-mechanical equipment for railway signalling purposes. His current post includes responsibility for all the activities of the Equipment Design Department and Equipment Sales Department of the Electrical Division of ML.



A fail-safe FDM control system for railway signalling

A special frequency division multiplex system for fail-safe transmission, originally designed by ML Engineering for a desert railway, is now finding wider rail applications. This article describes the system.

John Rose, BSc, CEng, MIEE, MIERE, MIRSE

The 'Tem L' Style 20 equipment was first created for the transmission of vital railway signalling controls over radio links for a newly constructed 260 km single line railway in Jordan, from El Hassa to Aqaba Port. The same equipment is being used for the re-signalling of the Glasgow underground system, to directly operate colour light signals at all stations around the Circle from a central control room.

Operating in the audio frequency range, the equipment is used for the transmission of vital information via noisy communication links, such as radio telephone channels, power carrier systems, or telecommunications cable. A variation of the same equipment can now be used to detect the presence of trains on railway track and at the same time pass control signals to the locomotives.

The transmitter is connected at one end of the track circuit and energises a trackside receiver at the other end of the track circuit typically up to 1200 m away. When a train occupies the section, it short-circuits the transmitter and the trackside receiver relays are then de-energised to provide controls for colour light signals and safety interlocking circuits. Since the transmitter short-circuit current circulates through the axle of the locomotive, this current may be detected by pick-up coils, the output of which are fed to a receiver mounted in the locomotive.

Operating principles

Each channel of the system (Fig 1) can transmit one out of six bits of information at any given time and up to 24 such channels are spaced throughout the range 1000 Hz — 3400 Hz. If the number of channels is limited to 16, these can be accommodated in the range 2000 Hz — 3400 Hz, thus allowing speech up to 2000 Hz to be transmitted at the same time.

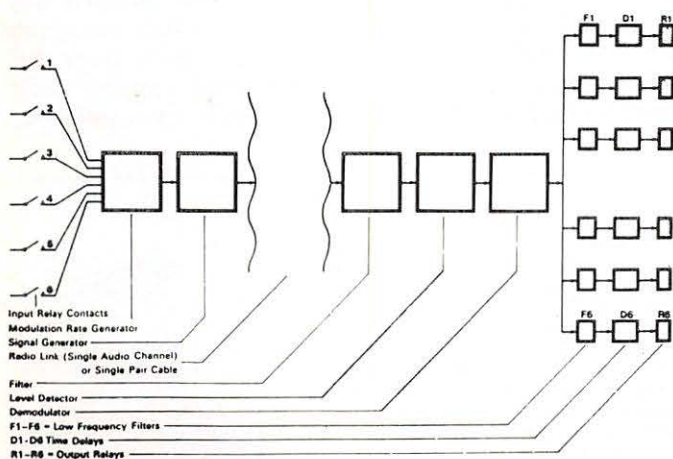


Fig 1. Block diagram of the basic system showing a single 'one-out-of-six' information channel; 24 similar channels may operate within a bandwidth of 3.4 kHz.

Each channel is arranged to shift from one to another frequency with both frequencies being detected independently. The frequency shift is performed at one-of-six unique modulation rates which are detected to provide a capacity of 'one out of six' bits of data per channel. The channels are spaced at approximately 120 Hz intervals throughout the range; the frequency shift is about 30 Hz and the modulation rates lie in the range 1 — 6 Hz.

A contact closure in the transmitter causes a low frequency generator to produce a specific low frequency signal which modulates the frequency of the carrier oscillator. This signal is buffered and fed to the transmission link via an isolating transformer.

At the receiving end, the signal is fed to two filter channels, each tuned to one of the two transmitter frequencies. After level detection and demodulation, the output is fed to a bank of band pass filters, which select the appropriate modulation rate, and after a predetermined delay time, operate an output relay, which corresponds to the circuit that was closed at the transmitter.

Fail-safe operation

In general a signalling system of this type is rendered 'fail-safe' by making operation of the circuit dependent on a number of parameters, each of which are themselves checked in a fail-safe manner. For example, in the system under consideration, the following parameters are checked at both transmitter and receiver:—

- Value of both carrier frequencies.
- Signal amplitude.
- Modulation rate of each carrier frequency.
- Mark to space ratio of each carrier frequency.
- Modulation of frequency.
- Continuity of signal.

All this checking inherently gives rise to lower reliability but this is compensated for by using high grade components operated at conservative ratings.

When considering the 'fail-safe' properties of circuit 'hardware', all possible failure modes of components must be considered. Most component failure modes are well known and others have been learned over many years of experience. In general, integrated circuit failure modes are too complex for such components to be considered in fail-safe circuits.

It is known that a bipolar transistor can fail with any two or all three terminations short or open circuit, or combinations of both, or to any value of resistance in any terminal. It is therefore usual to employ ac or 'balanced dc' techniques. It is quite common to employ transformers for fail-safe coupling as failures here can readily be detected.

It has been learned that certain types of resistor will fail only to a high resistance value, or open circuit. The

resistors in this category are single layer wire wound types and glass based tin oxide types. The single wound capacitor with extended foil welded terminations has shown characteristics of failure to open circuit, short circuit, or parallel leakage only. Some tuned circuits especially when series connected, have fail-safe properties and often tuned circuits of this type are used in multiple cascade mode.

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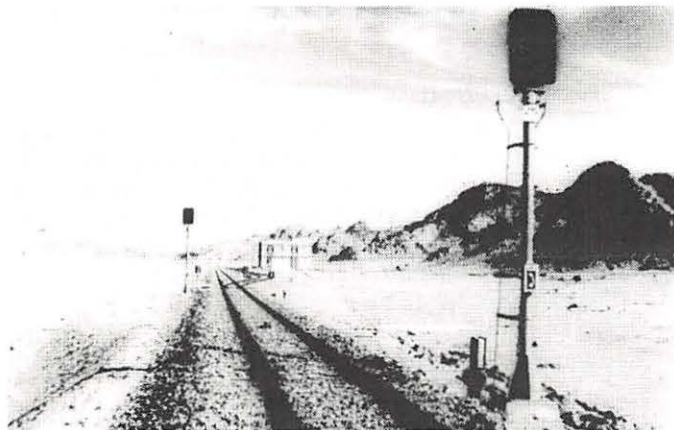


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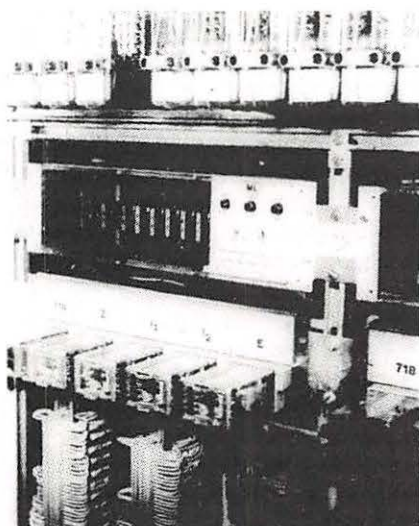


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Fig 4. Printed circuit board of the fail-safe transmitter unit.

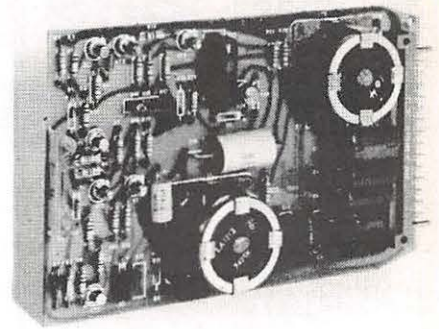
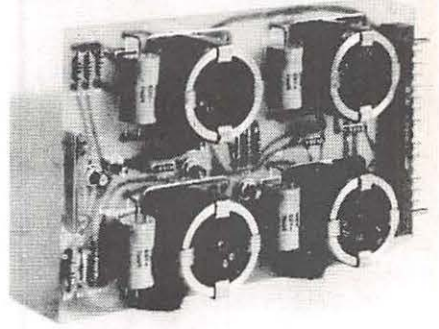


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The transmission equipment, known as Tem-L Style 20, uses printed circuit card (Figs 4 & 5) construction in 19 inch racking for ease of maintenance. A robust construction is used with single sided boards, a carefully spaced layout and high quality connectors. Where a surface leakage across the printed circuit copper tracks could set up a potentially dangerous condition, a shielding track is included between so that any leakage would always give a right side failure.

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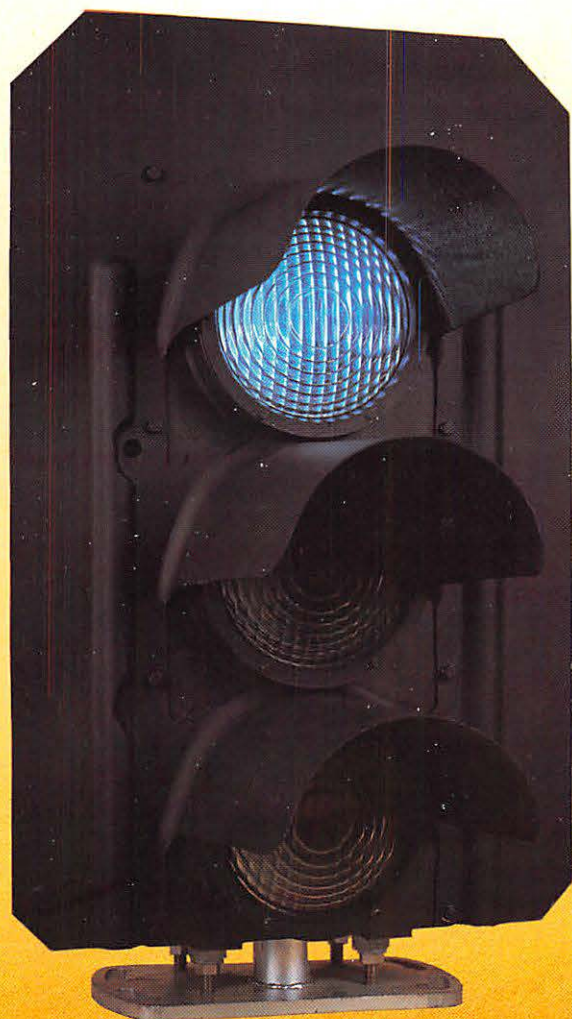
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ML

COLOUR LIGHT SIGNAL

STYLE 20



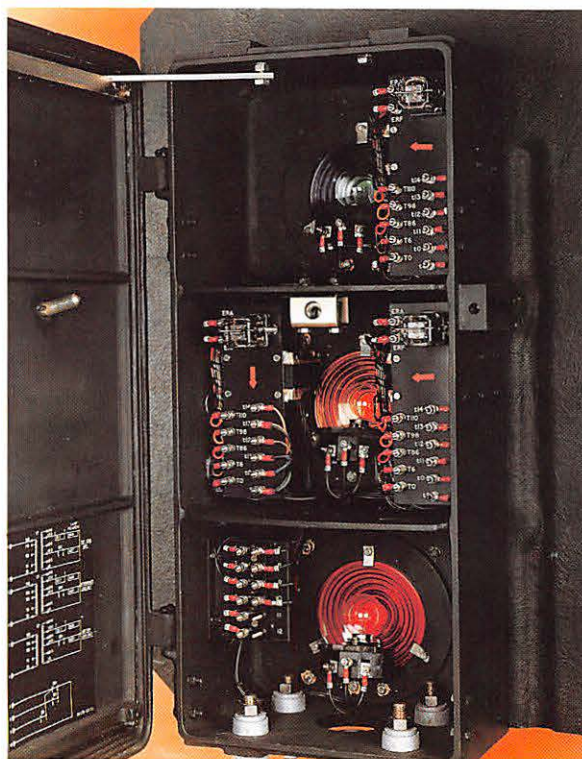
Colour Light Signal

Style 20

The colour light signal is designed for use as a main running signal for long or short-range viewing. It is available in 1, 2, 3 and 4 aspect versions and conforms to British Railway Board Standard Drawing BRS-SE81.

SPECIAL FEATURES

- Conforms to BRB Standard Drawing BRS-SE81.
- Cast aluminium alloy case and door eliminating corrosion and providing ease of maintenance.
- Case capable of supporting a full junction indicator without additional support in winds of up to 100 m.p.h.
- Easy access with simple door stay, sealing and padlocking arrangements.
- Single Piece Moulded Background/Hoods.



COLOUR LIGHT SIGNAL STYLE 20

TECHNICAL DESCRIPTION

Type of Signal

Various colour combinations are available for the aspect positions and these should be clearly specified at the time of ordering. The colour sequence should be specified starting with the bottom aspect colours; red, yellow and green in accordance with colour spec BR820 are regarded as standard. Other colours can be provided on request.

Case and Door

The case and door are each aluminium castings in 1, 2, 3 or 4 aspect form.

A neoprene gasketed rear door is hinged on the left hand side when viewed from the rear. Alternative holes for the hinge pin mountings are available in the main case to enable the door to be reversed on site so that it can be hinged on the right hand side when viewed from the rear. Door opening is restricted to 100° by a stay which can be disconnected to give 180° open when required. The door is held closed by a central screw and lever arm which can be padlocked on the exterior.

The case has sighting holes for track alignment purposes. If required the top of the case can be drilled with a centre cable hole tapped 1" BSP and four fixing holes of 18 mm diam on a 178 mm x 114 mm grid for the mounting by 16 mm bolts of a position light junction indicator. (ML STYLE 10 or ML STYLE 20). No additional support is required for such junction indicators since the main casting is designed to have sufficient strength to withstand wind loadings of 100 mph fitted with the largest junction indicator arrangement.

Special sealing arrangements for tropical environments have been developed and details are available on request.

Mountings

Signal heads may be supplied either with gantry mounts or pipe-post mounts.

Gantry Mounting Bracket

The gantry mounting has four fixing slots of 22 mm width on a 330 mm x 102 mm grid and provides a horizontal radial adjustment of + and - 10° and vertical tilt of + and - 5°.

Pipe-Post Mounts

Pipe-post sockets to allow the signal head to be mounted at the top of a pipe post are available to fit pipes of diam 140 mm or alternatively 168 mm. Complete horizontal radial adjustment is obtained and vertical tilt of + and - 5°.

Other Mounting Brackets

Various fabricated steel mounting brackets, offset mounting brackets, tubular steel signal poles and ladders are available as separate items. Quotations will be submitted against specific requests.

Approximate Weights

Fitted with GPR Hoods/Sighting Plates.

	<i>kgms</i>	<i>lbs</i>
1-Aspect	23.0	51
2-Aspect	35.4	78
3-Aspect	43.5	96
4-Aspect	65.3	144

Add 2.3 kgms (5lbs) Per Aspect for Transformer/ Relay Assemblies.

Add 4.5 kgms (10lbs) FOR GANTRY MOUNT or Add 10.9 kgms (24lbs) FOR PIPE-POST MOUNT

FINISH

The Signal is finished on all surfaces with matt black micaceous iron oxide paint. Other paint specifications can be accommodated if required. To minimise corrosion possibilities stainless steel screws, washers, nuts and fixings are used extensively.

Hoods and Sighting Plates

The 305 mm long hoods are integrally moulded with the 600 mm wide (or alternatively 508 mm wide) sighting plate as a one-piece glass reinforced plastic (GRP) moulding.

Individual hoods for each lens unit made in GRP, steel or aluminium are available as optional extras. Special hood adaptations designed to combat the effects of low angle intense sunlight can be provided if required. Details on request.

Individual sighting plates in sheet steel or aluminium are also available as optional extras.

Optical System

The optical system consists of an inner 140 mm diameter Fresnel lens to BRS Spec. SE88 (or 95) appropriately coloured to BR Spec. 820 and an outer 213 mm diameter clear Fresnel Lens to BRS Spec SE87 with deflecting sector (for clear viewing immediately below the signal). The standard position of the deflecting sector is considered as the lower right-hand quadrant, other positions required should be clearly specified.

The beam pattern of the above long-range lens combinations is approximately 7° in the horizontal and 2° in the vertical plane when used in conjunction with the main filament of the lamp to BS469 type SL35.

If a wider angle beam pattern is required an alternative 30° spreadlight outer clear lens is available.

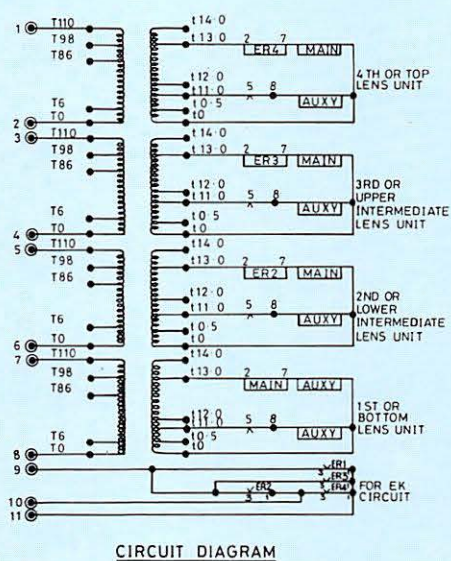
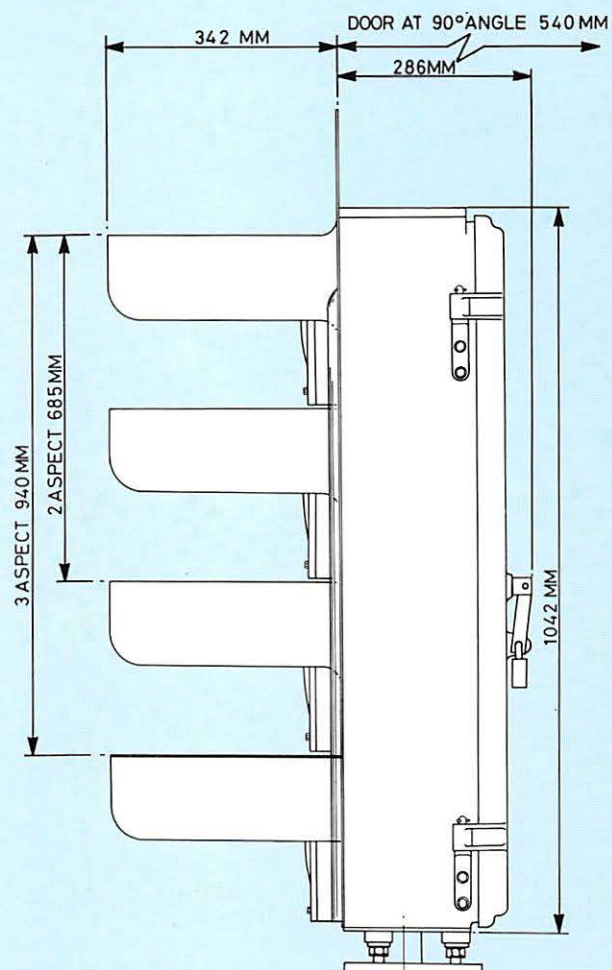
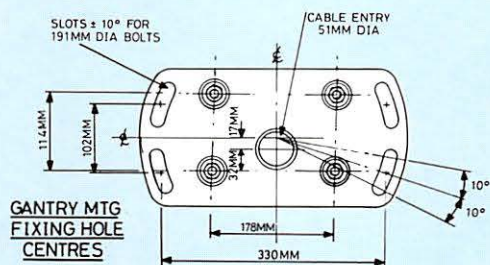
Iris plates are also available as optional extras to limit the aperture to 152 mm or 114 mm.

Where vandalism is a problem, a high impact clear polycarbonate outer lens can be provided as an alternative to the glass long range glass outer lens (BRS SE87).

Lamps and Lampholders

The lampholders are thermosetting plastic mouldings fitted with leaf-spring contacts and two (or three) 2BA terminals nuts and washers to BS57. The standard arrangement accepts 3 pm, 2 or 3 terminal railway signalling lamps to BS469.

The standard lamp is regarded as type SL35 to BS469. Alternative lamps can be accommodated but full details of such alternative requirements should be made when ordering. Signals, when despatched, are not normally equipped with lamps. If lamps required these should be ordered separately.



Colour Light Signal

Style 20

ELECTRICAL SYSTEM

The Standard arrangement is equipped with a transformer and filament changeover relay for each aspect. All terminals are 2BA to BS 57.

Alternative arrangements may be supplied without filament changeover relays. The 110 volt/12 volt transformers are fitted to the side of each aspect compartment (the transformer for the bottom aspect is fitted in the second compartment).

The standard transformer tapings are as follows:-

INPUT (50Hz)	OUTPUT
T110 volts	t14. 0 volts
T 98	t13. 0
T 86	t12. 0
T 6	t11. 0
T 0	t 0.50

The transformer will accommodate Signal Lamps in accordance with BS469 (Types SL34 and SL35) nominal rating 24 watts.

The filament switching relay is plugged into an octal base which is mounted on an extension of the transformer terminal board. Each relay has two changeover contacts, one which is used for switching to the auxiliary lamp filament on failure of the main filament and the other which is used for remote indication of main filament failure.

Cable entry is through a 50mm diam hole in the base of the signal.

A circuit diagram is attached to the inside of the rear door.

ORDERING INFORMATION

The following information for each signal head is required with order:-

1. Number of Aspects.
2. Colour of Aspects (reading from bottom to top).
3. Type of Outer Lens.
 - (a) Long Range with deflecting sector (glass)
 - or (b) 30° spreadlight (glass)
 - or (c) Polycarbonate version of long range with deflecting sector.
4. Position of outer lens deflecting sector. When looking at the front of Signal. Is sector required to be in lower right hand or lower left hand.
5. Mounting Base.
 - (a) Is Adjustable Gantry Base required.
 - or (b) Is Pipe Post Base required. If so what diameter post. (140mm or 168mm).
6. Hoods/Backplates. Are non standard sizes or materials required.
7. Are lamps Required.
 - (a) Standard. To BS.469 SL35
 - or (b) Standard. To BS.469 SL34
 - or (c) Standard. To BS469 SL17
 - or (d) any other type.
8. Are transformers required. If so are non standard, voltage tapings/ratings/frequencies needed.
9. Are Filament Changeover relays required.
10. Are IRIS plates required.
 - (a) To give 152mm aperture.
 - or (b) To give 114mm aperture.
 - or (c) Any other aperture size.
11. Is non standard paint finish required.

The data contained in this leaflet is as accurate and up to date as reasonably possible. Since it is our policy to be continually reviewing designs, it is possible that current equipment may vary slightly from that described.

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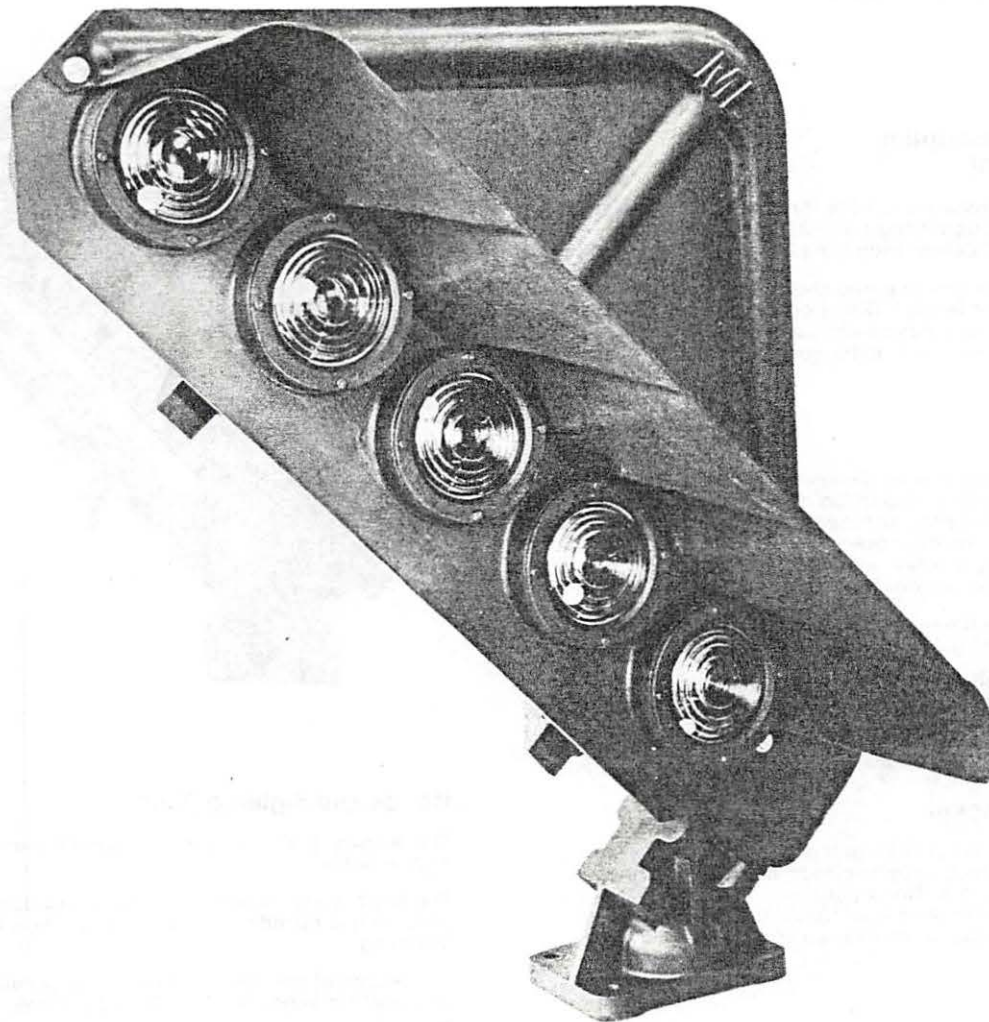
Electrical Division, Estover Close, Estover, Plymouth PL6 7PU, England.
Telephone: (0752) 702525; Telex: (0752) 45383 (MLPENG) Telefax: (0752) 701643.



ML

Single Arm Position Light Junction Indicator

Style 20



Single Arm Position Light Junction Indicator Style 20

The Single Arm Position Light Junction Indicator is a long range signal designed for use with a running signal to clearly indicate a junction ahead of the main signal.

The indication consists of five lunar white lights mounted in one arm pointing in the direction of the divergence. The arm is secured to a universal mounting bracket which allows for assembly to indicate right or left-hand turnout.

The Junction Indicator is normally mounted direct on top of a main colour light signal, however, gantry mounting and pipe post bases are available as optional extras.

Special Features

- Cast aluminium arm, door and bracket eliminating corrosion and providing ease of maintenance.
- Easy access with simple door and padlocking arrangement.
- Alternative mounting arrangements.
- Standard fixing centres.
- Available with or without transformers.
- G.R.P. hood and sighting plate combined.
- Prefocussed lens system.

Single Arm Position Light Junction Indicator

Style 20

Technical Information

Technical Description Type of Signal

Two combinations are available for position 1 (left-hand turnout) and 4 (right-hand turnout) and will in future replace Style 10 design Indicators of corresponding positions.

The layout of the arm required should be specified by No. 1 or No. 4, when ordering. Direct conversion is not possible in the field from one position to the other, but this feature can be made available at extra cost.

Arm

The rectangular arm is an aluminium alloy casting to BS. 1490 LM6 with an expanded neoprene gasketed rear door of aluminium alloy attached to the arm by means of two hinges. The door opening is downwards. The door is held closed by a screw with lever arm which can be padlocked on the exterior to a lug on the exterior of the door.

Externally at the lower end the arm has sighting holes for alignment purposes.

Internally, at the lower end the arm has provision for the mounting of a terminal block or transformer with integral terminal block as may be required.

Mounting Bracket

The mounting bracket is an aluminium alloy casting to BS. 1490 LM6 which permits choice of machining the arm for either the No. 1 or No. 4 position. The base is rectangular and contains four 18mm. diameter holes for 16mm. diameter fixing bolts on a 178mm. (7") x 114mm. (4½") grid.

Mountings

The standard arrangement is for the Junction Indicator to be mounted directly on top of a main colour light signal using a set of bolts which can be supplied with each Junction Indicator.

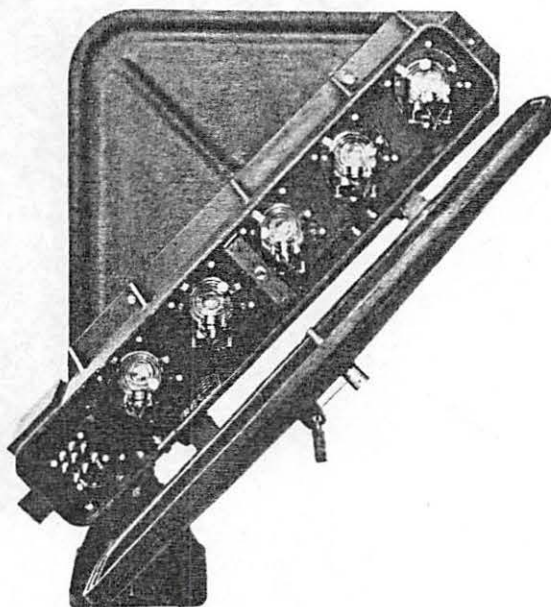
Pipe Post bases for both 140mm. (5½") and 168mm. (6½") outside diameter signal posts and gantry mounting bases are available as optional extras.

These are attached to the mounting bracket by the same set of bolts as can be supplied for attachment to the top of the signal.

Fabricated steel mountings and tubular steel signal poles are available as separate items. Quotations will be submitted against receipt of signal profile drawings or similar technical information.

Finish

The standard Junction Indicator is painted matt black all over or is available as an optional extra with any other paint finish that may be specified.



Hoods and Sighting Plate

The 305mm. (12") hood is of integral pattern and covers all five lights.

The hood is also integral with the background sighting plate as it is manufactured from G.R.P. as a composite moulding.

The design of the combined hood and sighting plate is universal for either No. 1 or No. 4 positions.

The arrangement is secured direct to the arm casting by four screws.

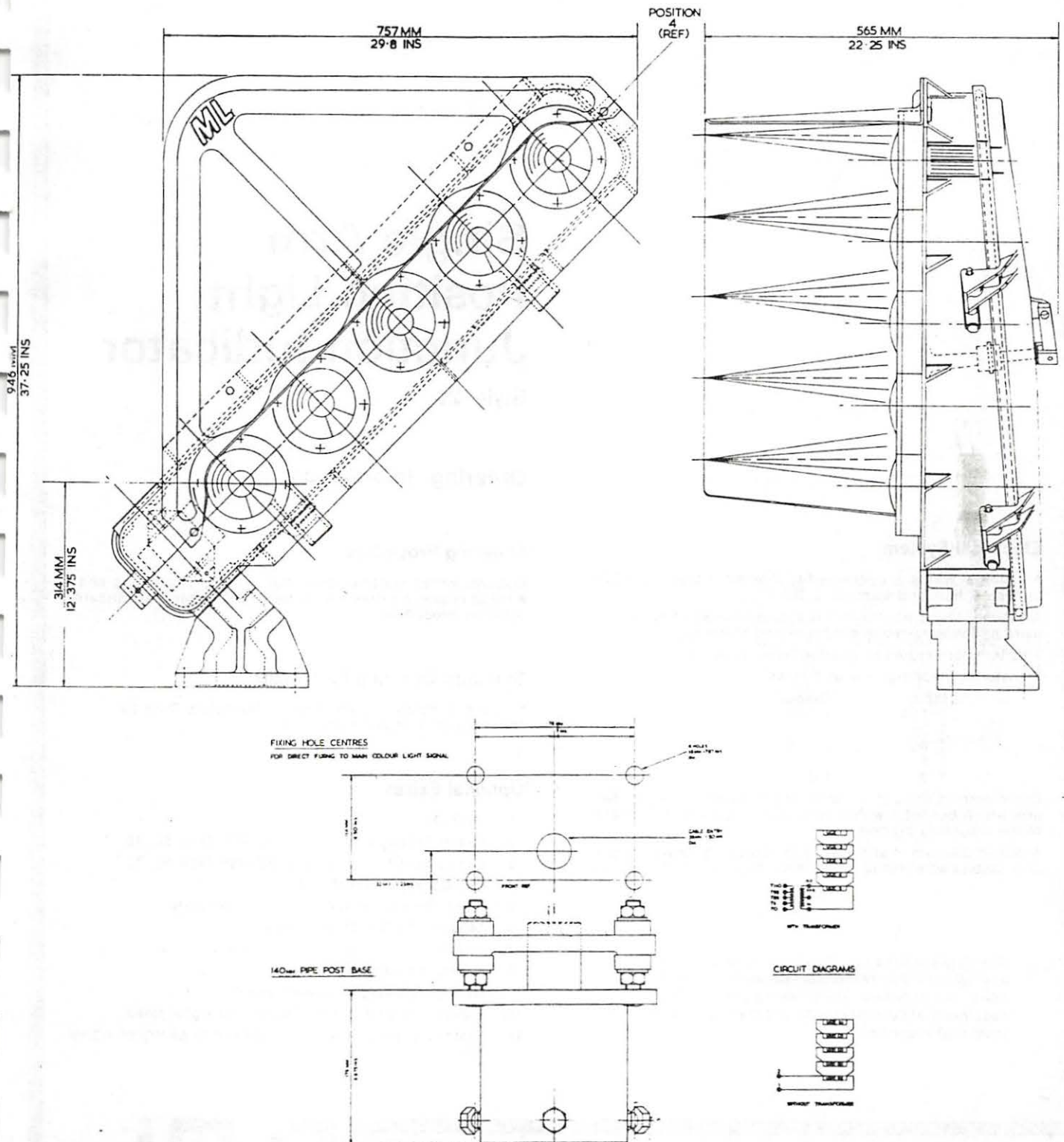
Optical System

The optical system consists of an inner 92mm. (3½") diameter lunar white Fresnel lens and an outer 127mm. (5") diameter clear Fresnel lens with deflecting sector normally in the lower right-hand, or as an alternative, left-hand quadrant if so ordered.

Lamps and Lampholders

The lampholders are thermosetting plastic mouldings fitted with leaf spring contacts and two 2BA terminals, nuts and washers to BS. 57. The standard arrangement accepts 3 pin 2 terminal railway signalling lamps to BS. 469. Lamps are available as optional extras.

Outline Drawing



Single Arm Position Light Junction Indicator

Style 20

Ordering Information

Electrical System

All internal wiring is connected to a terminal block with 2BA terminals, nuts and washers to BS. 57.

A 110volt/12volt transformer is available as an optional extra and is mounted in the lower end of the arm.

This transformer has an integral terminal block.

Transformer tapings are as follows:

Input	Output
T 110	t 12.0
T 98	
T 86	t 11.5
T 6	
T 0	t 0

Cable entry is through a 38mm. (1½") diameter hole in the arm which connects with a corresponding entry in the base of the mounting bracket.

A circuit diagram is attached to the lower inside wall of the arm casting adjacent to the terminal block or the transformer.

The data contained in this leaflet is as accurate and up to date as reasonably possible. Since it is our policy to be continually reviewing designs, it is possible that current equipment may vary slightly from that described.

Ordering Procedure

Optional extras must be specific at the time of ordering and a list of required extras should be added under the standard ordering procedure.

Standard Ordering Particulars

Single Arm Position Light Junction Indicators Style 20
arm position 1 or arm position 4.

Optional Extras

1. Padlocks
2. Lamps railway signalling to BS. 469 Type SL. 18
3. Lamps railway signalling to BS. 469 Type SL. 33
4. 110volt/12volt transformer
5. Paint finish to be specified if non-standard
6. 140mm. (5½") O.D. pipe post base
7. 169mm. (6⅝") O.D. pipe post base
8. Gantry mounting base with tilt
9. Gantry mounting base without tilt
10. Fastenings for Junction Indicator to signal head
11. Fastenings for gantry mounting base to gantry or signal pole

M.L.Engineering (Plymouth) Limited

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Telephone: Plymouth (0752) 702525 Telex: 45662 Cables: ELECEMEL Plymouth



ML

POSITION LIGHT SIGNAL

STYLE 50



Position Light Signal

Style 50

This position light signal is available as either a two aspect shunt signal or as a single aspect subsidiary signal. The signal is suitable for ground level or elevated mounting and complies with British Railways Board specification BRS-SE160.

SPECIAL FEATURES

- Cast aluminium alloy housing and door, minimising corrosion and providing ease of maintenance.
- Wide angled, close up, doublet diffusing lens system 88 mm diameter.
- Railway Signal Lamps to British Railways Board specification BRS-SE163.
- Ease of access provided by simple retained lift off door with padlocking facilities.
- Integral cast aluminium hoods with provision for attachment of extended hoods.

POSITION LIGHT SIGNAL STYLE 50

TECHNICAL DESCRIPTION

Standard two-aspect (shunt)

Standard shunting signals display two lunar white lights inclined at 45° for the "OFF" aspect and, alternatively, with one red light (or yellow) disposed horizontally. Both aspects use a common lunar white pivot light.

Standard one-aspect (subsidiary)

Standard subsidiary signals display two lunar white lights inclined at 45° for the "OFF" aspect only. Normally all other aspects are inferred by an associated main signal. The same signal housing is used for both the two aspect and single aspect signal but in the case of the latter the third light position is blanked off.

Non-standard optical arrangements

A wide variety of lens colours and displays (for example alpha-numerical stencils) may be accommodated within the basic signal housing. Any enquiry for a non-standard arrangement should be clearly described.

Case and Rear Cover

The case is an aluminium alloy casting with mounting feet designed for two M16 bolts, spaced on 165 mm centres and provided with slots permitting plus and minus 5° of horizontal angular adjustment.

Internal separator plates are fitted to isolate each lamp compartment and prevent light transference between aspects.

The rear door is an aluminium alloy casting with closed-cell expanded neoprene gasket and it is held in place by a robust central screw with lever arm which can be padlocked. A short length of plastic chain attaches the rear door to the main body casting.

Back Lights

Standard shunt signals, two aspect, to BRS-SE160 have a back light fitted to the rear door in the pivot light position. Subsidiary signals are normally not fitted with back lights.

Additional back lights can be fitted to the rear doors on all types of position light signals to customers special order.

Optical System

The optical system to British Railways standard BRS-SE161 consists of an inner inverted torric lens to BRS-SE97 together with an outer Fresnel diffusing lens to BRS-SE99.

In the case of the lunar white lamp unit the inner lens is supplied with the outer lens as clear and the inner lens coloured.

This doublet arrangement ensures that all risks of phantom effects are virtually eliminated.

Back lights on the rear door each consist of a small aluminium alloy casting with a 25 mm diam. clear aspect.

Lamps and Lampholders

The optical system is specifically designed to accommodate 110 volt 35 watt BC lamps complying with British Rail Standard BRS-SE163/1 which features a tungsten filament and 3 pin 2 terminal cap.

Lamps are not normally supplied, but can be supplied as an optional extra.

The 3 pin 2 terminal lamp holder is a thermol setting plastic moulding to BS 771 Type GX which is fitted with phosphor bronze leaf spring contacts and brass nickel plated 2BA terminals, nuts and plain washers to BS 57, designed to accommodate insulated ring type compression terminations to BS 4579 part 1.

Electrical System

All internal wiring is connected to a central terminal block with separate terminals being provided for each lamp unit and wired in accordance with BRS-SE162. The terminal block is a 2BA standard railway signalling type to BRS-SE37 with nuts and plain washers to BS57.

Cable entry is through a 1" BSP tapped hole in the signal base or, as an alternative, through a side entry hole which is normally blanked off by a plug to which is connected the door retaining chain. When the alternative entry hole position is used the plug is removed and screwed into the cable entry hole in the signal base.

All wiring connections are made in P.V.C. black insulated cable to BS 6231 Type B single 30/0.25 mm equivalent to 1.5 mm squared electrical cross section. All wiring connections are terminated by 2BA ring type-insulated compression type terminals to BS 4579 part 1.

Finish

Standard signals are finished with all forward and side faces in matt black micaceous iron oxide paint and the rear face of the door in micaceous iron oxide silver grey paint. Any other paint specifications are however available as an optional extra.

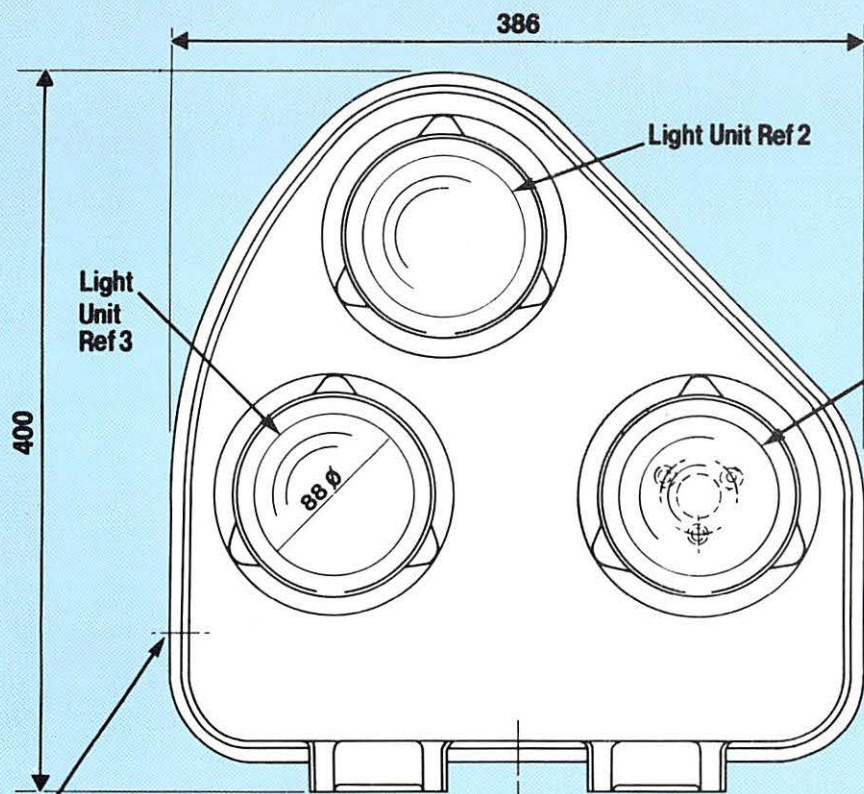
Hoods

The standard hood, 75 mm long, is cast integrally with the lens housing of each light unit and each subsidiary signal (one aspect) is supplied with fixings attached to the integral short hoods so as to permit longer hoods to be fitted. Being normally ground mounted, shunt signals (two aspect) are not normally fitted with extended hoods and therefore provision is not made in this instance for the fitting of such hoods. However, such provision can be made to customers special order.

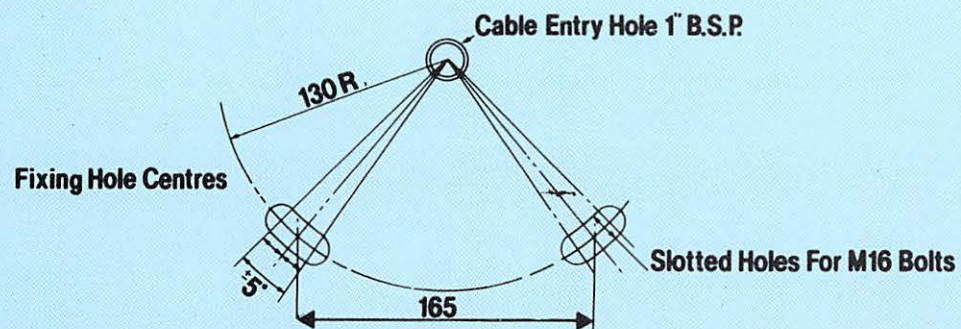
The standard extended hood is 152 mm long of aluminium alloy sheet to BS1470. Longer hoods can be accommodated if required.

Mountings

A wide variety of arrangements of fabricated steel mountings and brackets are available. A second signal or arrangement of stencil route indicators may be used in conjunction with the signal. Such additional extras are normally supplied against receipt of specific signal profile information.



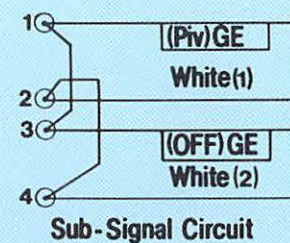
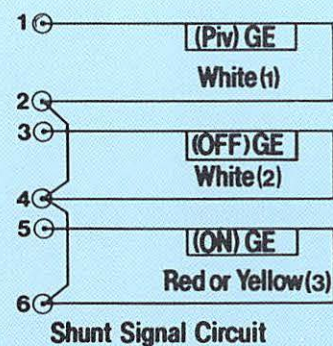
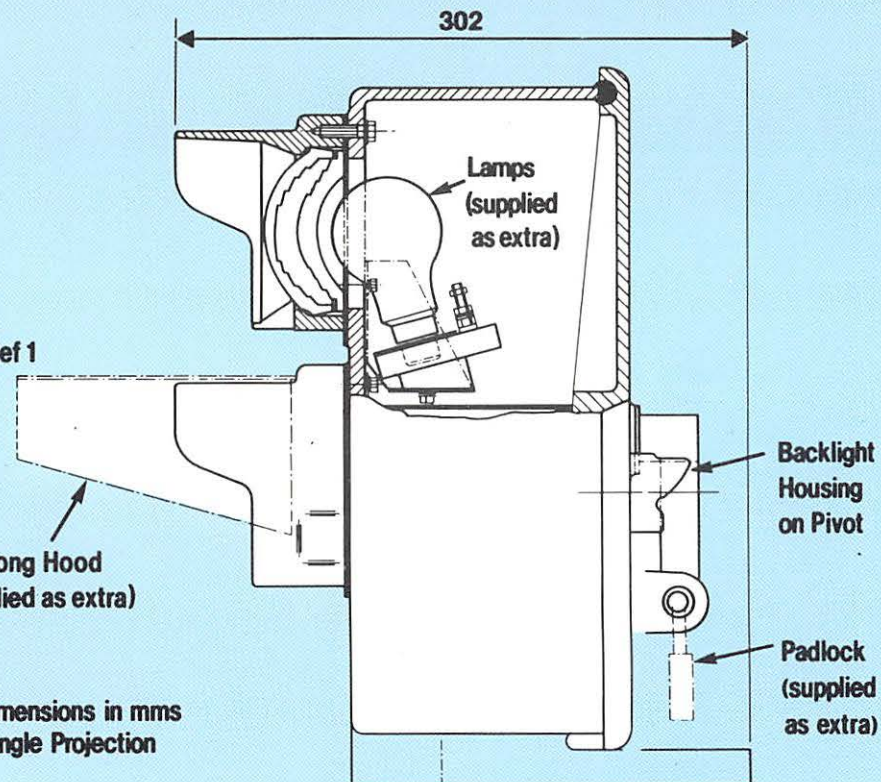
1" B.S.P. Cable Entry (alternative)



Light Unit Ref 1

152 Long Hood
(supplied as extra)

All Dimensions in mms
3rd Angle Projection



Approximate weight 13 kgms

Position Light Signal

Style 50

ORDERING INFORMATION

Standard signals are normally supplied strictly in accordance with BRB specification BRS-SE160. Optional extras as listed below should be specified at the time of ordering.

The standard alternatives are:-

- (a) **Position Light Shunt Signal – Style 50**
The colour of light unit ref 3 should be specified either red or yellow. The other two light units are lunar white.
- (b) **Position Light Subsidiary Signal – Style 50**
Both light units are lunar white.

OPTIONAL EXTRAS

- 1. Extended aluminium alloy hoods – length to be specified (152 mm long are considered standard)
- 2. Additional backlights – positions to be specified
- 3. Without backlights
- 4. Padlock – type to be specified
- 5. Lamps to BRS-SE163/1, 110 volt 35 watt 3 pin
- 6. Alternative paint finish – full specifications required
- 7. Non-standard colours of signal aspects and/or stencil details
- 8. Alternative lampholders and lamps. Not recommended if optimum optical performance is required
- 9. Special mounting brackets

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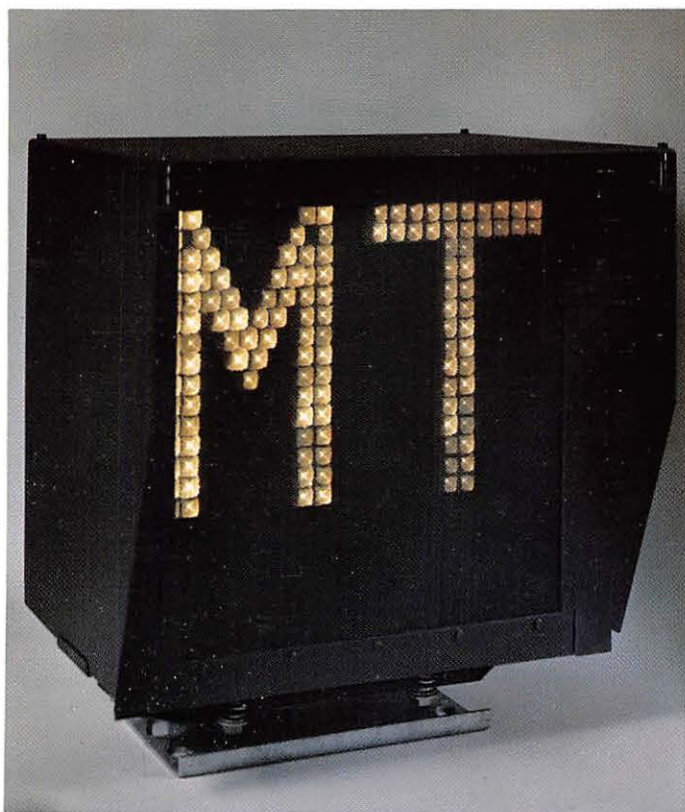
ML Engineering (Plymouth) Limited

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Telephone: (0752) 702525; Facsimile: (0752) 701643;
Telex: 45383 MLPEN G; Cables: Emel Plymouth

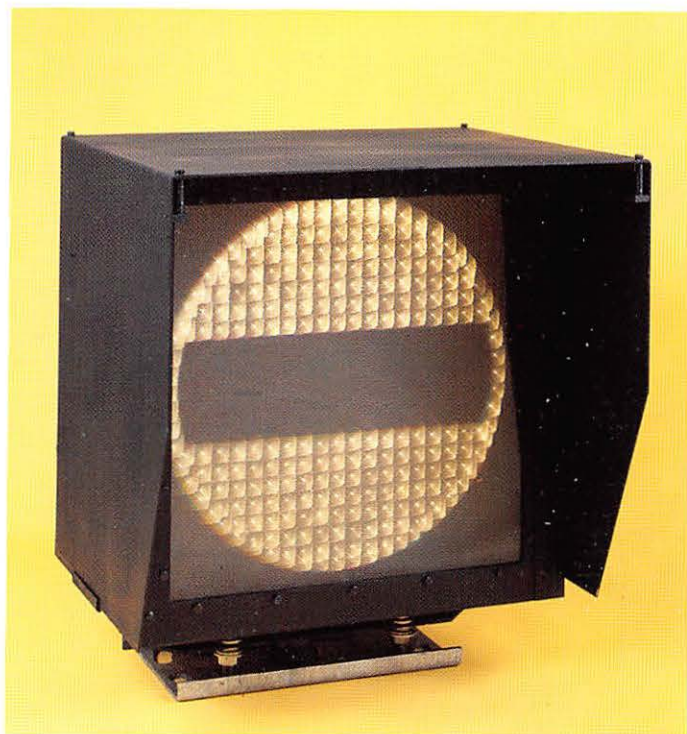


FIBRE OPTIC ROUTE INDICATORS

STYLE 10



ROUTE INDICATOR STYLE 10



BANNER REPEATER SIGNAL STYLE 10

KEY FEATURES

- Designed for tropical environments.
- Rear access to all principal components.
- Unit includes transformers, lamps units, light guides in a compact arrangement.
- Lightweight fabricated steel base, designed to resist wind loads exceeding 200km/hr.
- Fabricated light alloy construction of low weight.
- Cable entry seal excludes insects, but permits ventilation and drainage.
- Door and stay suitable for left hand or right hand hinge fixing and secured by screw fastener capable of padlocking.
- Polycarbonate front screen resists vandalism and provides dispersion for close up viewing and good character definition.
- Hood slides back and over case for cleaning of the front screen when required.

FIBRE OPTIC ROUTE INDICATOR SIGNAL STYLE 10

TECHNICAL DESCRIPTION

The Fibre Optic Indicator Style 10

is intended to be used in conjunction with a main colour light signal (typically an ML Style 20) to provide an indication to the driver of the identity of the route ahead. The unit is capable of displaying several alternative characters.

The unit is designed to provide a clear indication up to a range of 350 metres even in conditions of bright, low-angle sunlight or other adverse weather conditions. In this respect the use of fibre optics is superior to more orthodox methods of illumination which are less reliable because of the multiplicity of lamp units. With fibre optic indications, only one source of illumination is required for each character and duplicate indications are readily accommodated.

Because, in general, a single lamp is used per indication, rather than a combination of lamps, only simple arrangements for lamp proving need be used and lamp replacement need take only a few minutes.

Each illuminated character is made up from a row of glass fibre optics snapped into a front plate and each character has its own set of light guides, lamp unit and transformer. The size of the character(s) may be up to 440mm high and 440mm wide. Each basic unit can accommodate, depending upon their complexity, up to seven alternative indications. (Up to fourteen indications can be accommodated in an enlarged case if required. Contact ML for further details.)

The Fibre Optic Banner Repeater Signal Style 10

is intended to be used to provide a driver with an early indication of the aspect of a main signal which is not yet in sight. The moving arm of a traditional banner repeater signal is replaced by an arrangement of fibre optic units which provide the necessary pattern for a black, rectangular arm on a white illuminated background. Separate fibre optic arrangements are used to provide the two required indications – arm at horizontal and arm inclined at 45°.

The unit is designed to provide a clear indication up to a range of 350 metres even in conditions of bright, low-angle sunlight or other adverse weather conditions. The use of fibre optics eliminates the moving parts and the need to back-light the signal at night. By using a dual arrangement of fibre optics for each indication a greater degree of reliability is achieved and, if required, one set of fibre optic units can be switched off at night to reduce the brightness of the signal. Because

only four lamps are used, two per indication, only simple lamp proving arrangements need be used and lamp replacement is quick and easy.

Each illuminated indication consists of two separate arrangements of fibre optic end units fitted into a front plate. The units are interspersed so that in the event of a failure of one set, the other will continue to provide the indication, at slightly reduced brightness.

Each arrangement has its own set of light guides, lamp unit and transformer.

The diameter of the indication is 445mm, with the 'arm' 150mm wide.

Construction

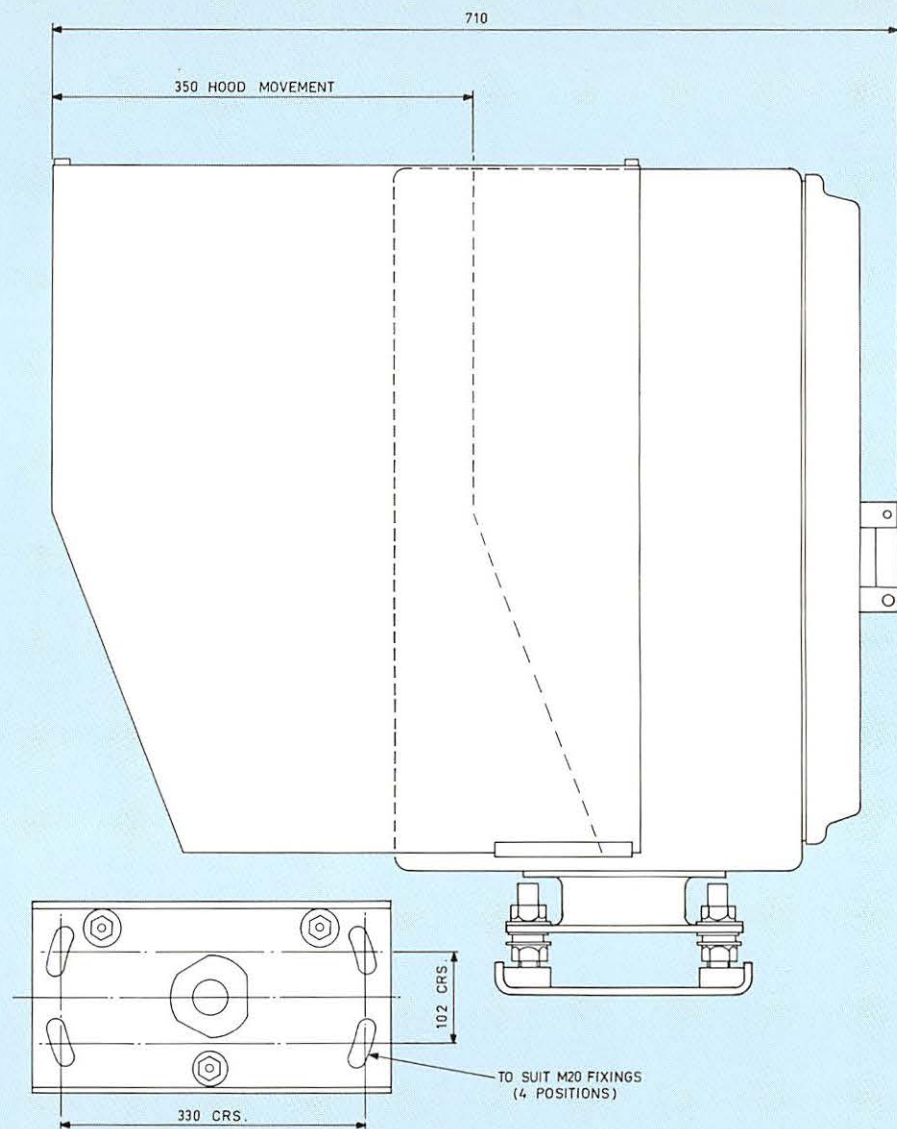
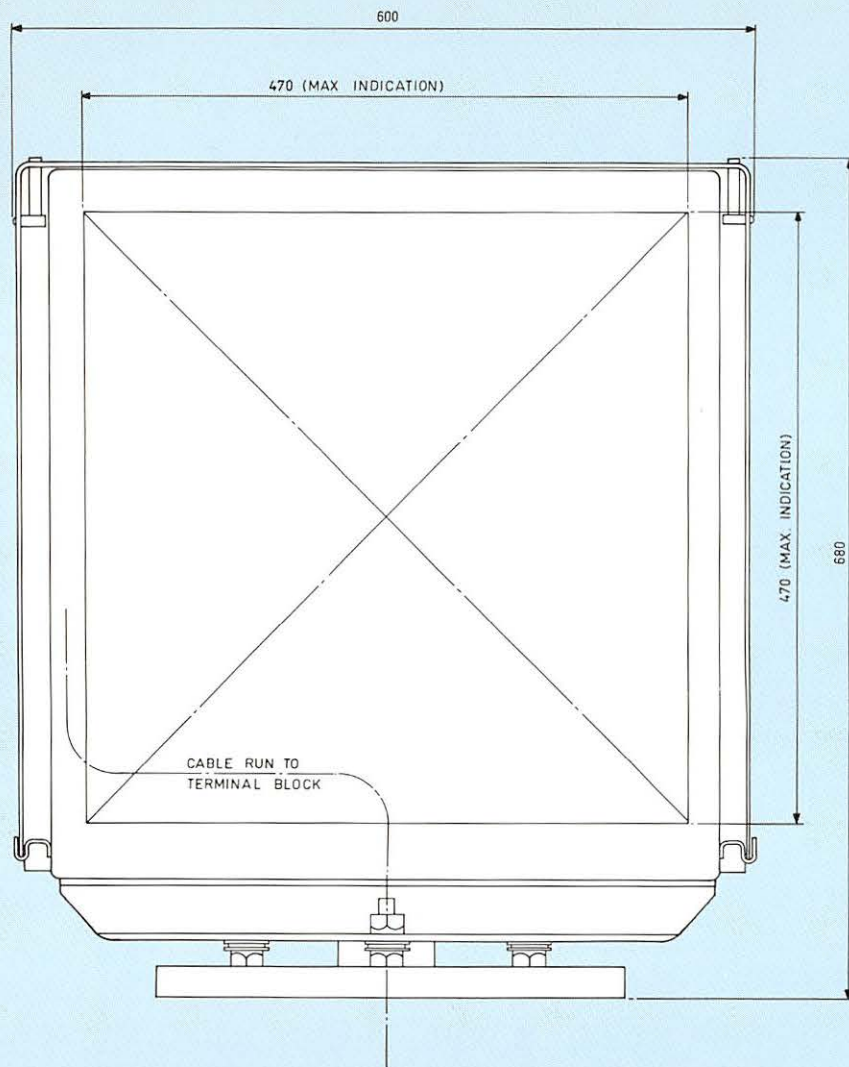
The main case is fabricated from 3mm light alloy sheet to BS1470 NS4 and contains brackets to which the fibre optic assembly is secured. The bottom of the case is arranged to accommodate a gantry-type base with adjustments for tilting and swivelling the indicator up to 6° for sighting purposes. The lower corner of the case is provided with a tubular sighting device.

The door, fitted with a weathertight seal, is fabricated from 2mm alloy to BS1470 NS4 and is complete with hinge lugs and a screw-type fastener. Universal left hand or right hand hinge attachments are provided. The door fastener, which has provision for padlocking, is protected from inclement weather and seizure from corrosion is obviated. The door is fitted with a stay to limit opening to 100° and 160° when released. A 2mm polycarbonate scratch and vandal resistant front screen is gasketted to the front of the case. An independent 280mm long, 2mm thick alloy hood is fitted which, on removal of the lifting eye on the top of the case, may be slid back to facilitate cleaning of the front screen.

Mounting

A 3mm thick fabricated steel gantry base is provided with four-hole fixing on British Rail standard 330mm X 102mm centres for M20 fixings. Projecting above and secured in the base are three M16 studs to which the indicator is attached by conical nuts, spring, and plain washers to enable adjustment for sighting. The studs and associated items are in stainless steel. A 38mm diameter cable entry tube is sealed around the Indicator base by a dimpled plate which is spring loaded and this plate allows condensation within the Indicator Case to drain away whilst preventing entry of insects.

If required, the gantry base can be substituted by a combination pipe post socket to suit customer's signal post. Mountings are designed to resist wind loads exceeding 200km/hr.



GENERAL OUTLINE ARRANGEMENT FOR A FIBRE OPTIC ROUTE INDICATOR SIGNAL STYLE 10.

FIBRE OPTIC ROUTE INDICATOR SIGNAL STYLE 10

Optical System

Each light guide terminates in a special ferrule which fits into an end unit fitted into a suitably drilled front plate. The opposite ends of the light guides are bundled and secured in a moulding mounted in a square tubular housing across the main support frame. The housing carries the halogen lamp unit and reflector directly facing the termination of the light guide bundle. A quartz halogen 12 Volt 50 Watt lamp operates at a nominal 10.8 volts to give an extended lamp life. Spare light guides are supplied within the unit. Lamp replacement is effected from the rear of the signal by opening the door and depressing the lamp ejector lever.

Electrical System

A transformer having a primary voltage of 110 volts and a secondary voltage of 10.8 volts 50Hz is provided for each lamp unit. Other primary voltages can be provided as an option. Transformers in accordance with BR Spec. 824A are fully tropicalised and fitted with 2BA standard BS57 screw terminals for termination of incoming cables.

Finish

The Indicator is finished matt black throughout internally and externally using micaceous iron ore paints suitable for tropical environments. All fixings are stainless steel to obviate corrosion problems.

Dimensions

The width of the Indicator is maintained within 600mm to avoid infringement of structure gauges and to comply with standard width of British Rail Colour Light Signals.

Approximate Weights

(including mount)

43kgs

95lbs

ORDERING PARTICULARS

The unit should be ordered as a:

- (1) Fibre Optic Route Indicator Style 10, giving Number, Type and combination of characters required;

or

- (2) Fibre Optic Banner Repeater Signal Style 10.

The following information should accompany either order:

- (3) Input voltage if non-standard (standard voltage is 110V, 50Hz).
- (4) Lamp proving, if required.
- (5) Pipe Post Mounting, if required (Gantry type mounting is standard.)
- (6) If pipe post mounting is required, state size of post.
- (7) Environmental operating conditions.
- (8) Paint finish, if non-standard (standard is matt black throughout).

SPARES

It is recommended that spare lamps are ordered at the same time as the signal. These lamps are Quartz Halogen 12 Volts 50 Watts with a nominal lamp life of 2000 hours at rated voltage.

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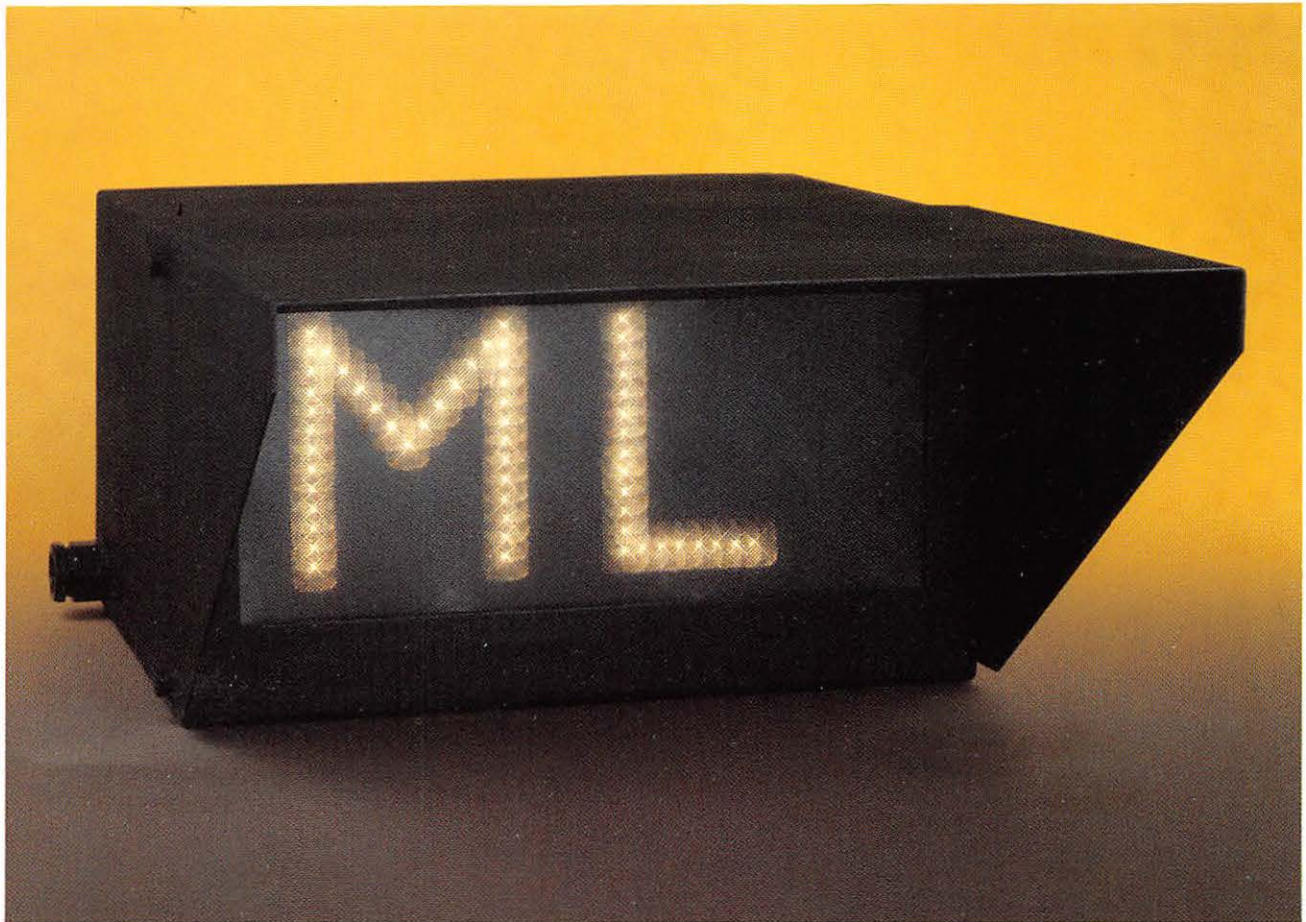
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Telex: 45383 MLPEN G; Cables: Emel Plymouth





FIBRE OPTIC ROUTE INDICATOR

STYLE 20



KEY FEATURES

- Designed for tropical environments.
- Rear access to all principal components.
- Unit includes transformers, lamp units, light guides and lenses in a compact arrangement.
- Fabricated light alloy construction of low weight.
- Lightweight fabricated steel base, designed to resist wind loads exceeding 200km/hr.
- Cable entry seal excludes insects, but permits ventilation and drainage.
- Door and stay suitable for left hand or right hand hinge fixing and secured by screw fastener capable of padlocking.
- Polycarbonate front screen resists vandalism and provides dispersion for close up viewing and good character definition.
- Hood slides back over case for cleaning of the front screen when required.

FIBRE OPTIC ROUTE INDICATOR

STYLE 20

TECHNICAL DESCRIPTION

The Fibre Optic Route Indicator Style 20

is intended to be used in conjunction with a shunt or main colour light signal to provide an indication to the driver of the identity of the route ahead. Each unit is capable of displaying several alternative indications.

The unit is designed to provide a clear indication up to a range of 100 metres, even in conditions of bright, low-angle sunlight or other adverse weather conditions. With fibre optic characters, only one source of illumination is required for each indication and up to three characters per indication can be accommodated.

Because, in general, a single lamp is used per indication, rather than a combination of lamps, a single arrangement for lamp proving can be adopted and lamp replacement is quick and easy.

Type of Signal

Each illuminated character consists of a single row of fibre optic end units fitted into a front plate. Up to three characters form an indication which has its own set of light guides, lamp unit and transformer. The size of the indication can be up to 160mm high and 373mm wide.

Each basic unit can incorporate up to five separate indications, but additional indications can be accommodated by assembling two or more basic units together, one above the other.

Construction

The main case is fabricated from 3mm light alloy sheet to BS1470 NS4 to which internal angle guides are fitted. The vertical front plate, light guides, lamp units and transformers are assembled onto a horizontal baseplate as one unit. This baseplate can be slid in and out of the case, on the angle guides, via the rear door.

The door, fitted with a weather-tight seal, is fabricated from 2mm light alloy to BS1740 NS4 and is complete with hinge lugs on its lower edge and a screw-type fastener. The door fastener, which has provision for padlocking, is protected from inclement weather and seizure from corrosion is obviated.

A 2mm polycarbonate scratch and vandal resistant front screen is gasketed to the front of the case. An optional glass screen may be used in place of the polycarbonate screen.

Mounting

The base is provided with two fixing holes on British Rail standard 165mm centres for M16 fixings. A cable entry gland for 18mm to 24mm diameter cable can be fitted on either side of the case.

If required, a fabricated, steel combination pipe post socket can be fitted to suit customer's signal post. Mountings are designed to resist wind loads exceeding 200km/hr.

Optical System

Each light guide terminates in a special ferrule which snaps into a plastic end unit fitted in the holes of a suitably drilled front plate. The opposite ends of the light guides are bundled and secured in a moulding mounted in a square tubular housing. The housing carries the halogen lamp unit with the reflector directly facing the termination of the light guide bundle. The quartz halogen 12V 50W lamp operates at a nominal 10.8 volts to give an extended lamp life. Spare light guides are supplied with the unit. Lamp replacement is effected from the rear of the unit by opening the door and depressing the lamp ejector lever.

Electrical System

A transformer having a primary voltage of 110V, and a secondary 10.8 volts 50Hz is provided for each lamp unit. Other primary voltages can be provided as an option. Transformers in accordance with BR Specification 824A are fully tropicalised and fitted with 2BA standard BS57 screw terminals for termination of incoming cables.

Hoods

305mm hoods are available as optional extras. Manufactured from 2mm aluminium, they can be provided to fit either single or double indicator units.

Finish

The indicator is finished matt black throughout internally and externally using micaceous iron ore paints suitable for tropical environments. All fixings are stainless steel to obviate corrosion problems.

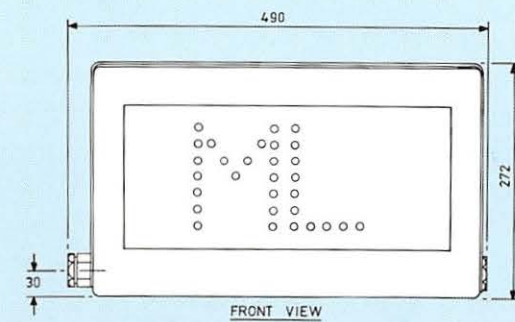
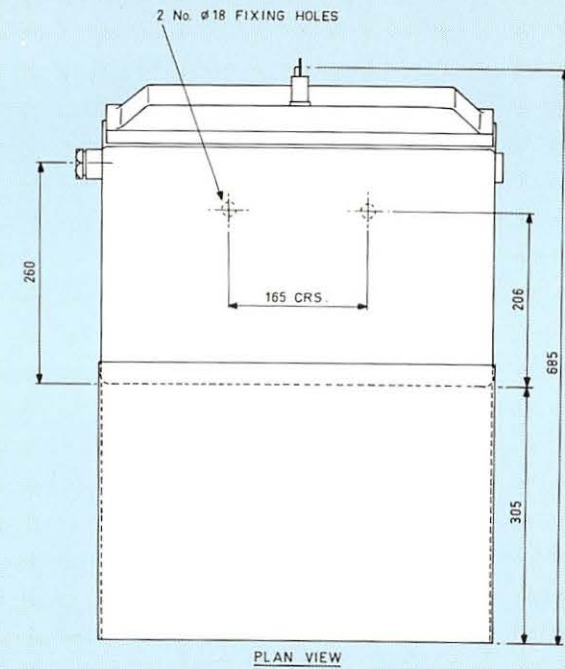
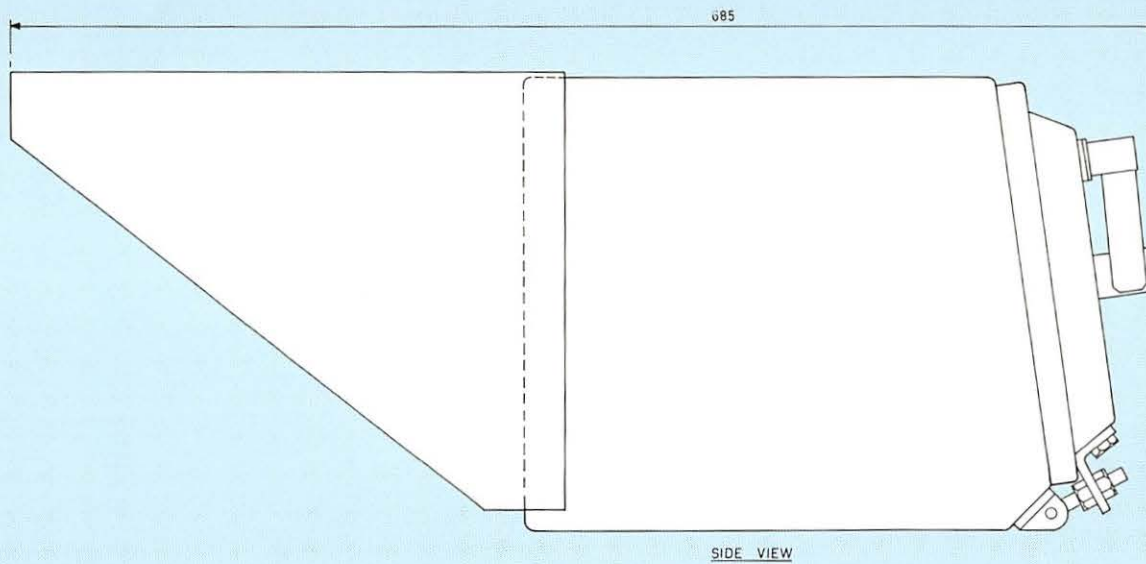
Dimensions

The width of the indicator is maintained within 500mm to avoid infringement of structure gauges and gantries.

Approximate Weights (including mount)

16 kgs

35lbs



GENERAL OUTLINE ARRANGEMENT FOR A FIBRE
OPTIC ROUTE INDICATOR STYLE 20.

FIBRE OPTIC ROUTE INDICATOR

STYLE 20

ORDERING INFORMATION

The unit should be ordered as: Fibre Optic Route Indicator Style 20, and the following information should accompany the order:

- (1) Number, type and combination of characters required.
- (2) Single or double unit (5 separate indications max. per single unit).
- (3) Single or double hood, if required.
- (4) Input voltage, if non-standard (standard voltage is 110V, 50Hz).
- (5) Lamp proving, if required.
- (6) Type of front screen, if non-standard (2mm polycarbonate diffusing screen is standard).
- (7) Pipe post mounting, if required.
- (8) If pipe post mounting is required, state size of post.
- (9) Environmental operating conditions.
- (10) Paint finish, if non-standard (matt black throughout is standard).

SPARES

It is recommended that spare lamps are ordered at the same time as the indicator(s). These lamps are Quartz Halogen 12V 50W with a nominal lamp life of 2000 hours at rated voltage.

The information contained in this data sheet is as accurate and up-to-date as is reasonably possible. Since it is the policy of the company to be continually reviewing designs, it is possible that current equipment may vary slightly from that described.
E. & O.E.



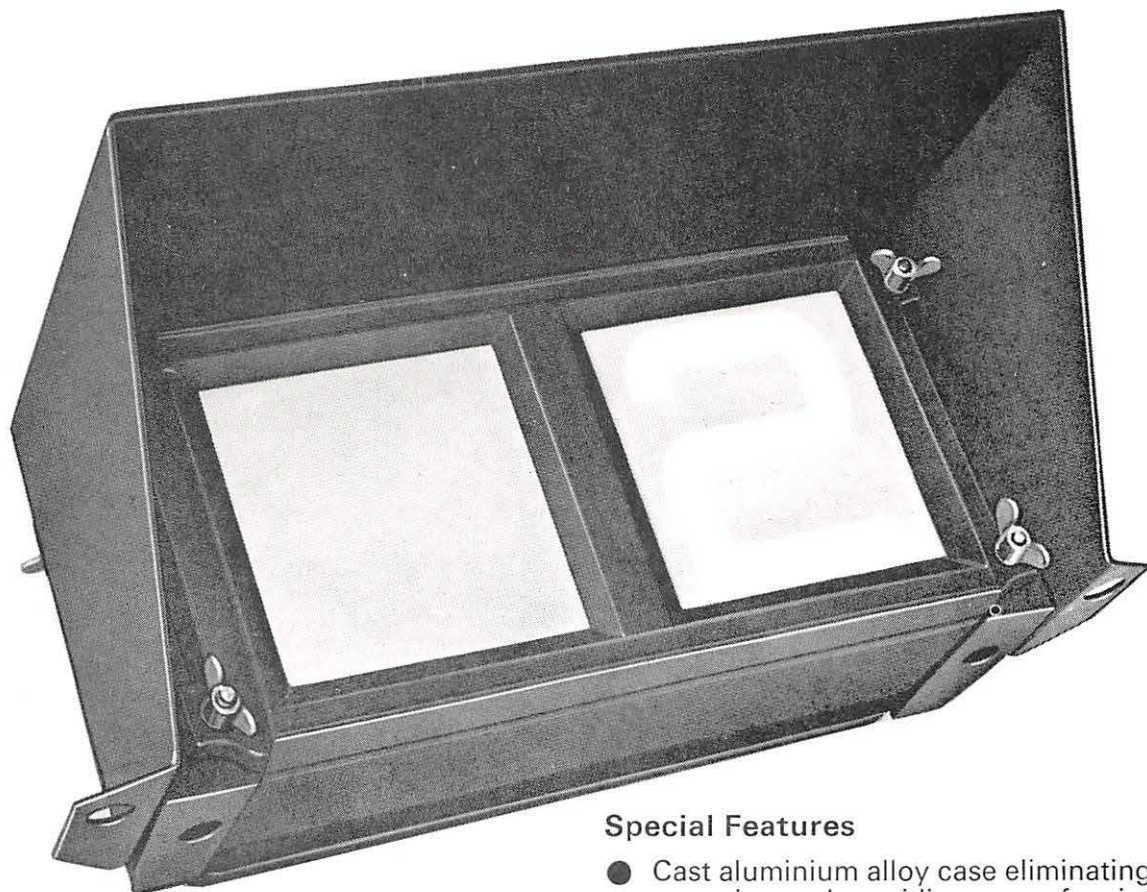
M.L. ENGINEERING (PLYMOUTH) LTD

Estover Close, Estover, Plymouth PL6 7PU, Devon, England.
Telephone: (0752) 702525; Facsimile: (0752) 701643;
Telex: 45383 MLPEN G; Cables: Emel Plymouth



Stencil Route Indicator 127mm (5in)

General Description



Stencil Route Indicator

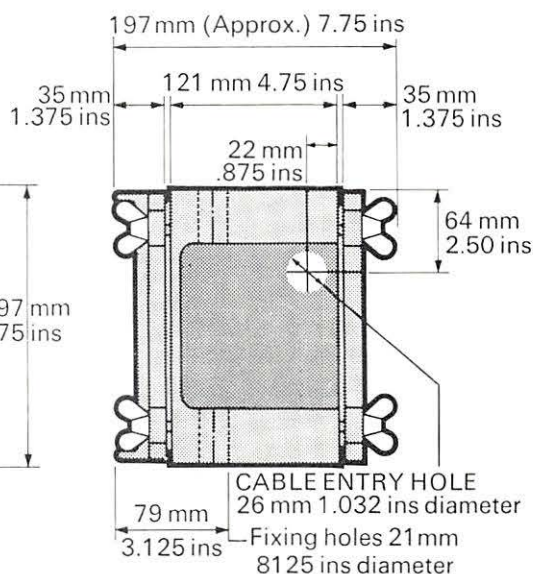
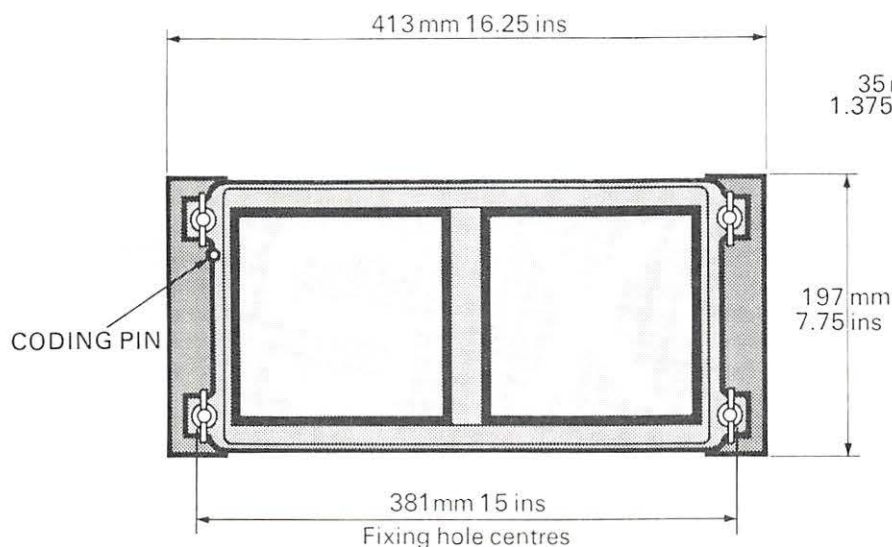
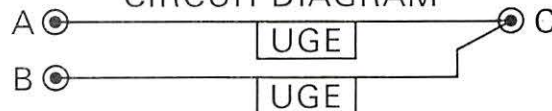
The stencil route indicator is used to provide an indication of which route the train has to take when there are any number of alternative routes from any one signal.

The stencil route indicator is normally mounted in association with a position light signal.

Special Features

- Cast aluminium alloy case eliminating corrosion and providing ease of maintenance.
- Easy access with removeable front and rear covers.
- Multiple mounting arrangements.
- High intensity illumination with parabolic reflectors.

CIRCUIT DIAGRAM



TECHNICAL DESCRIPTION

Type of Signal

Each indication takes the form of internally illuminated numerals or letters. Any quantity of alternative indications can be accommodated by assembling two or more basic units together. Each basic unit can display either two separate single letters or numerals or one combined indication of up to four letters.

Case

The case is an aluminium casting with stainless steel studs and detachable front and rear covers. The case has two holes of 20.6mm ($\frac{13}{16}$ in) diameter for mounting the indicator to a base plate or for attachment of additional stencil indicators. Three holes at each end of the case permit variable pin coding ensuring correct replacement of front covers and therefore stencil characters, should the front have been removed for any reasons such as cleaning or lamp replacement. The front cover is a light alloy casting with recessed section(s) for the insertion of stencil glasses and is fixed to the main body studs by brass wing nuts. A satisfactory seal is obtained by the use of PVC closed cell foam tape inserted between the two casting surfaces.

The rear cover is also a light alloy casting with four internal projections which provide mounting points for reflector units. The rear cover is secured to the main case in a similar manner to the front cover.

Mountings

A number of alternative methods are available for mounting the stencil route indicator. Quotations will be submitted against receipt of signal profile drawings.

Finish

The indicator is painted matt black with a matt black hood or is available as an optional extra with any other paint finish that may be specified.

Hoods

152mm (6in) steel hoods are available as optional extras and are a single, dual or triple combination of stencil indicators. Similar hoods in sheet aluminium are also available as optional extras.

Optical System

The optical system consists of an inner glass plate with a letter or numeral stencil (maximum of 4 letters in a single compartment) and an outer pot blue flashed opal glass plate. Both plates are sealed with glazing compound into the recessed section(s) of the front cover to prevent the ingress of water between the two glasses.

The 127mm (5in) stencil is a black painted and fired outline giving a clear stencil on the front surface of the glass sheet. The stencil plate is assembled with the black face adjacent to the blue surface of the second plate which has its white face to the exterior. This ensures that the indications are secret until illuminated. As an alternative, a steel blanking plate can be provided for the dual compartment type indicator when only one indication is required.

Stainless steel parabolic reflectors are attached to the rear cover. The reflectors give a greatly enhanced optical performance.

Lamps and Lampholders

The lampholders are standard commercial Batten type brass 2 pin, 2 terminal. The arrangement accepts 2 pin general service lamps to BS. 161 and takes lamp caps to BS. 52 Type B22. Lamps are available as optional extras. Stray illumination between either compartment of the dual indicator is eliminated by gasket sealing of the lampholder plate to the main case.

Electrical System

All internal wiring is connected to a central terminal block with separate terminals being provided for each lamp unit. All terminals, nuts and washers are 2BA to BS. 57.

Cable entry is through a 25.4mm (1in) diameter hole in the end section of the main case.

A circuit diagram is attached to the inside of the rear cover.

ORDERING INFORMATION

Ordering Procedure

Standard alternatives are shown in brackets and should be substituted for the relevant portion of the standard arrangement as required. Optional extras must be specified at time of ordering and a list of required extras should be added under the standard ordering procedure.

Standard Ordering Particulars

A stencil route indicator dual compartment with left-hand side indication (please state letter, numeral or blanking plate) and right hand side indication (please state letter, numeral or blanking plate).

A stencil route indicator single compartment with indication (please state combination of up to 4 letters).

For multi indications please supply sketch showing relative positions of each indication required.

Optional Extras

1. 152mm (6in) sheet steel hood for single stencil indicator.
2. 152mm (6in) sheet steel hood for double stencil indicator.
3. 152mm (6in) sheet steel hood for triple stencil indicator.
4. 152mm (6in) aluminium hood for single stencil indicator.
5. 152mm (6in) aluminium hood for double stencil indicator.
6. 152mm (6in) aluminium hood for triple stencil indicator.
7. Lamps commercial 2 pin 2 contact BC 110 volts 40 watts.
8. Lamps commercial 2 pin 2 contact BC 110 volts 60 watts.
9. Paint finish to be specified.

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M.L.Engineering (Plymouth) Limited

Electrical Division, Estover Close, Plymouth, PL6 7PU, England

Telephone: Plymouth (0752) 702525 Telex: 45662 Cables: ELECEMEL Plymouth





EARTH LEAKAGE DETECTOR

STYLE D5



- Detection of high resistance earth leakages for both AC and DC systems.
- Busbar Voltages up to 650V.
- British Railways Board Standard Relay Mounting centres.
- Visual Indication of leakage for each busbar.
- Remote alarm/indication contacts.
- Latching arrangement on alarm to detect intermittent faults.
- Time delay to reject effects of transients or interference.
- Operational checking facility via separate earth terminal.



Earth Leakage Detector

Style D5

TECHNICAL DESCRIPTION

GENERAL

The earth leakage detector Style D5 is designed to detect, and indicate, earth leakage on either busbar of a single phase AC or DC supply. It is suitable for use on busbars of up to 650V r.m.s. The sensitivity is internally variable and is adjusted, during manufacture, to a customer's individual requirement, maximum sensitivity being of less than 0.5mA of earth leakage. Earth leakage paths of up to 100 Kohms on a 24 volt busbar can be detected and the sensitivity increases in proportion to the busbar voltage. The unit is designed for shelf or rack mounting on British Railways Board standard relay centres and occupies three British Railways Board standard relay widths. The unit is completely solid state apart from the indication relays.

DETECTION

The earth leakage detector connects two identical impedances in series between the busbars and connects the mid-point of these impedances to earth via a further impedance. Any further connection to earth on either busbar moves this point out of balance which is detected by the unit. The out-of-balance current flows through a resistive load and the voltage produced is offered to the inputs of two voltage detectors, the direction of current flow determining which detector is operational.

A filter with a five-second time constant on the input to each detector ensures that neither surges nor interference gives a false alarm. If activated, each detector has a stick circuit to hold the alarm even if the fault disappears. A reset button is provided to clear the stick circuit once the earth fault has been cured.

Detection is indicated in two ways. One of two normally illuminated light emitting diodes on the front panel will be extinguished and one of two changeover relays (one controlled by each detector) will provide contacts for remote indications or alarms. The relay contacts are connected to terminals on the front cover.

The test circuit provides two push buttons, one for each busbar, depression of which places a leakage on that busbar. The unit detects this in the normal way.

CONSTRUCTION

The earth leakage detector is made up of two sub-assemblies on printed wiring boards mounted on a mild steel plate. Front and rear mild steel covers are attached to the frame and the whole unit is enclosed with mild steel perforated sheet.

MOUNTING

Four fixing holes in each of the front and rear covers, tapped 2BA for mounting to BRB standard relay centres.

TERMINALS

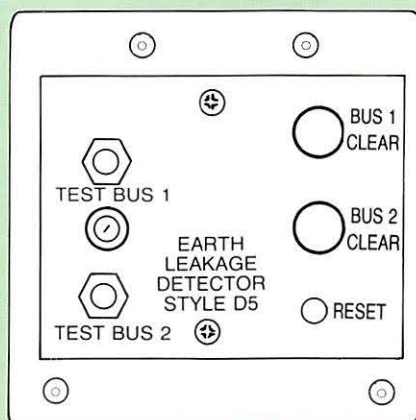
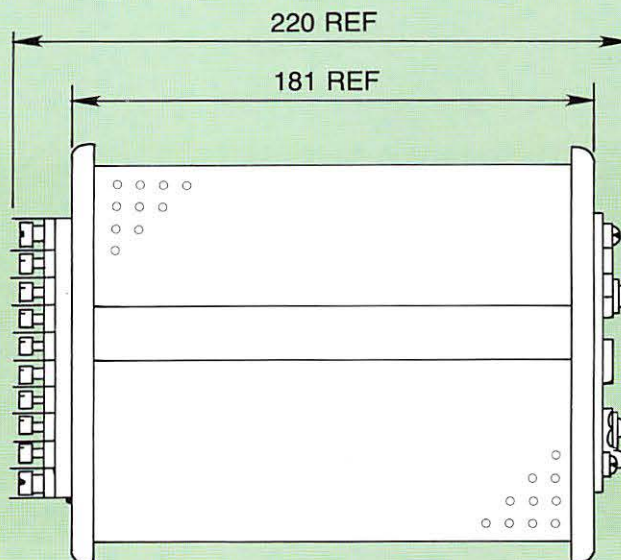
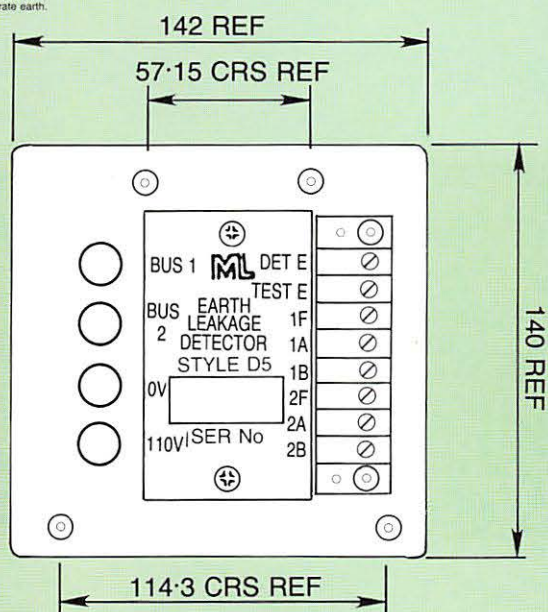
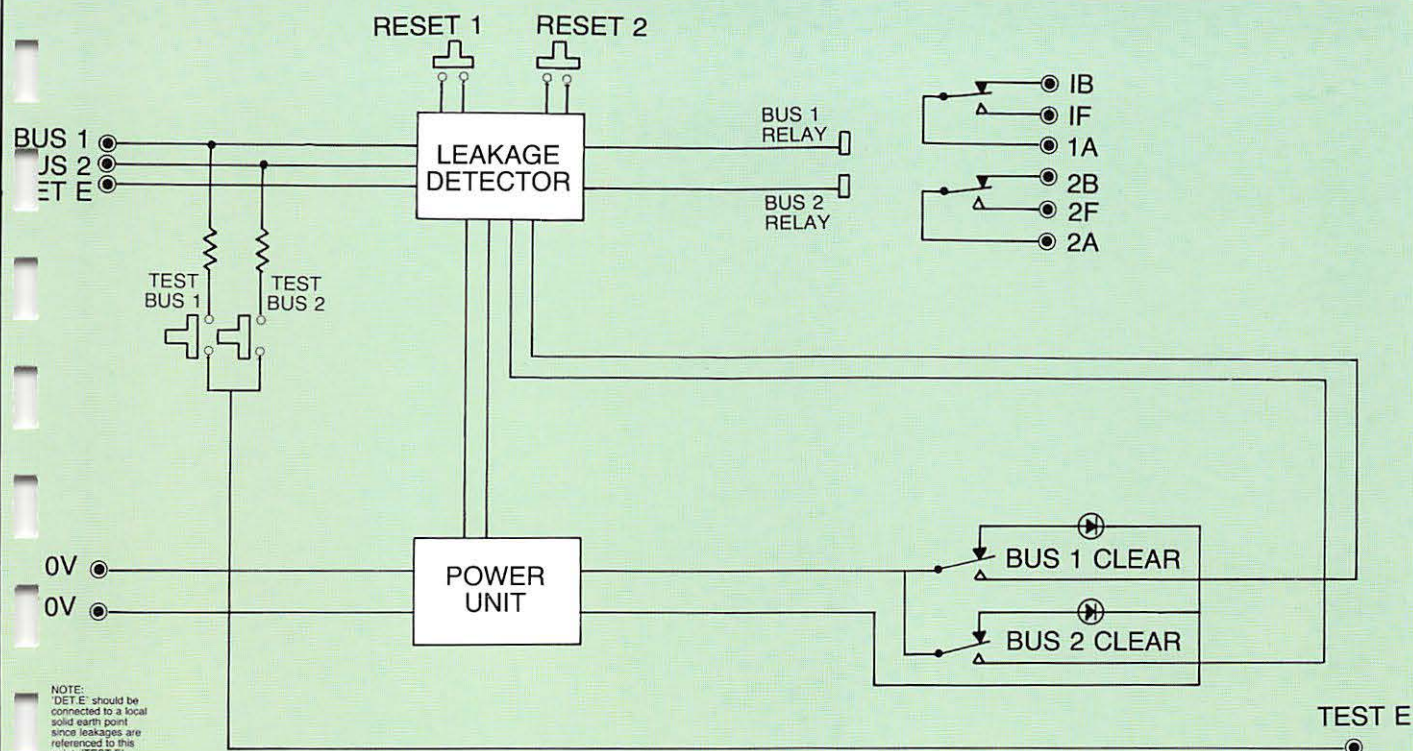
Busbar and power supply connections are to insulated terminals.

Indication contacts and earth connections are to pinch screw 2BA terminal blocks to BS57.

For busbar voltages above 120V, it is recommended that a protective shield be placed over the terminals and a suitable 'danger' label be fitted.

FINISH

The unit is finished in matt black stove enamel paint.



Earth Leakage Detector

Style D5

SPECIFICATION

Supply Voltage:	110V +10% r.m.s. A.C. 50Hz -20%
Supply Frequency:	40Hz to 70Hz
Busbar Voltage:	Up to 650 volts r.m.s. A.C. or D.C. (single phase)
Power Consumption:	Clear 1VA Fault 3VA
Sensitivity:	Factory preset up to a maximum of 100 Kohms on a 24 volt system. Sensitivity is busbar voltage dependent. Unless otherwise requested, units are set to 40 Kohms
Detection Delay:	Five seconds nominal
Detection Indication:	LED extinguished indicates leakage. Separate LED for each busbar. Changeover contact for remote alarm having contact rating:- 3A @ 120V a.c. 2A @ 250V a.c. 1.25A @ 50V d.c.
Busbar and Power Supply Connections:	Individual insulated terminals
Indication and Earth Connections:	Pinch screw 2BA terminal blocks to BS57
Temperature Range:	-20°C to +70°C
Size:	150mm x 140mm x 220mm
Mounting:	Four holes, tapped 2BA, on front and rear covers arranged for standard BRB relay centres. 2BA fixing screws are provided.
Components:	Comply with BR Spec. 950
Humidity and Vibration:	Comply with BR Spec. 967 Cat. D

ORDERING INFORMATION

Order should quote; Busbar voltage (r.m.s.) A.C. or D.C.,
Busbar frequency,
Sensitivity – setting if non-standard.

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M.L. ENGINEERING (PLYMOUTH) LTD.,

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Telephone: (0752) 702525; Telex: (0752) 45383 (MLPENG) Telefax: (0752) 701643.





Point Detectors Styles 1&2



Electric Point Detector Style 1

The point detector is designed for use in the detection of point tongues for facing or trailing points. It is also available with facing point lock detection and conforms to British Railways Board Specification 998B. The point detector can be arranged for mounting either in between or outside the running rails.

The style 1 unit covers strokes of 95 to 125 mm.

Electric Point Detector Style 2

As Style 1 but the Style 2 unit covers strokes of 110 to 150 mm.

Special Features

- **Conforms to BRB Specification 998B.**
- **Easy access with detachable cover and padlock.**
- **Easy removal of mechanical or electrical sub-assemblies for replacement.**
- **Weather sealed limit-switches.**
- **The point detector can be mounted in between or outside the running rails.**

Point Detectors

Technical Information

Types of Detector

The point detector is available either as a 2-blade unit for trailing points or as a 3-blade unit for facing points. The third blade is substituted for two spacing blocks in the 2-blade arrangement and the changeover either way can be effected on site very quickly.

Construction

The point detector is made up of two basic sub-assemblies mounted on a common mild steel base plate. A sheet steel or G.R.P. cover fits over the whole assembly and can be padlocked on the exterior.

The mechanical sub-assembly consists of two radius arms on a common pivot and two or three detector blades and their guides.

The electrical sub-assembly consists of an aluminium cast terminal box and two limit-switches mounted externally to the terminal box. A gasketed cover is fitted to the terminal box.

This means that when replacing mechanical components it is not necessary to disturb the electrical connections and vice versa.

The base plate contains four 17.5mm. (11/16") diameter holes for fixing bolts on a 76mm (3") x 203mm. (8") grid.

Mechanical Sub-assembly

The two radius arms are mounted on a common pivot pin; however each arm operates independently of the other.

Three rollers are fitted to each arm and these rollers ride on the surface of the three detector blades and only engage in the detection notch when all notches are in line vertically.

The initial setting of the detector is obtained by altering the relative positions of the notches by adjusting the locknuts on the threaded portion of the detector rods, and lock rod if fitted, where they pass through the drop lugs.

The switch detector blades have two notches immediately opposite each other on either side of the blade to allow for easy handling of the detector. The blades can be removed, turned round and re-inserted on site without any re-adjustment inside the detector being necessary. A drop lug is welded to one end of each detector switch blade.

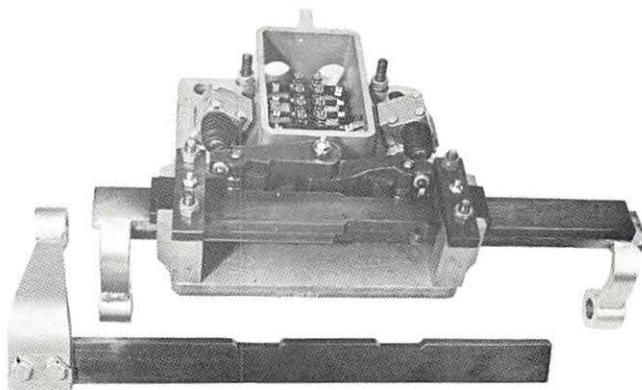
The lock detector blade has two notches both on the same side. These line up with both the right and left-hand radius arms so that providing the facing point lock is fully home the detection can be made whether the points are normal or reverse. The lock detector blade has a detachable drop lug which can be unbolted and refixed on the other side of the blade to effect handing. The lug fixing bolts should be trapped after the selection of the correct lug position by the tab washer provided.

Two spacing blocks can be substituted for the lock detection blade when facing point lock detection is not required. This can be effected on site.

All drop lugs are 21mm. (13/16") internal diameter to accept 19mm. (3/4") detector rods.

Lubrication

Satisfactory mechanical operation is obtained by the application of grease to three grease nipples, one on the central pivot and one each on the detector guides. Light oil is applied to each of the roller pivot pin ends.



Mounting

The detector can be mounted either between or outside the running rails.

If the detector is to be mounted between the running rails no mounting bracket is required. The detector should be mounted in the same manner as a facing point lock with the detector blades arranged so that one drop lug is positioned on either side of the detector. Very short detector rods then connect with two switch extension pieces of similar length. This gives a very compact layout but is only suitable for trailing points.

If the detector is to be mounted outside the running rails then either a two-blade or a three-blade layout can be accommodated. The detector can either be mounted on ordinary sleepers in which case the drop lugs are positioned on the far side of the detector from the running edge and the rods are taken underneath the detector. If long timbers are available, then the detector can be mounted with the top drop lugs on the side nearest to the running edge and the rods are taken in the conventional manner.

In either position a mounting bracket is necessary to suspend the detector between two sleepers.

The layout and lengths of detector and lock rods is identical in both cases and conforms to B.R.B. standard point layouts. All mounting brackets and sets of point fittings are available as optional extras.

Electrical Sub-assembly

The contacts take the form of two limit-switches which are mounted one on each side of the terminal box. The limit-switches are each driven by their appropriate radius arm and only a very small movement of the radius arm is necessary to break the detection contact.

The connections to each limit-switch are taken to a common terminal block. The connections are so arranged to enable the back contact of the non-detected side to be proven in series with the front contact of the detected side. **It is essential that this is done when preparing wiring diagrams.**

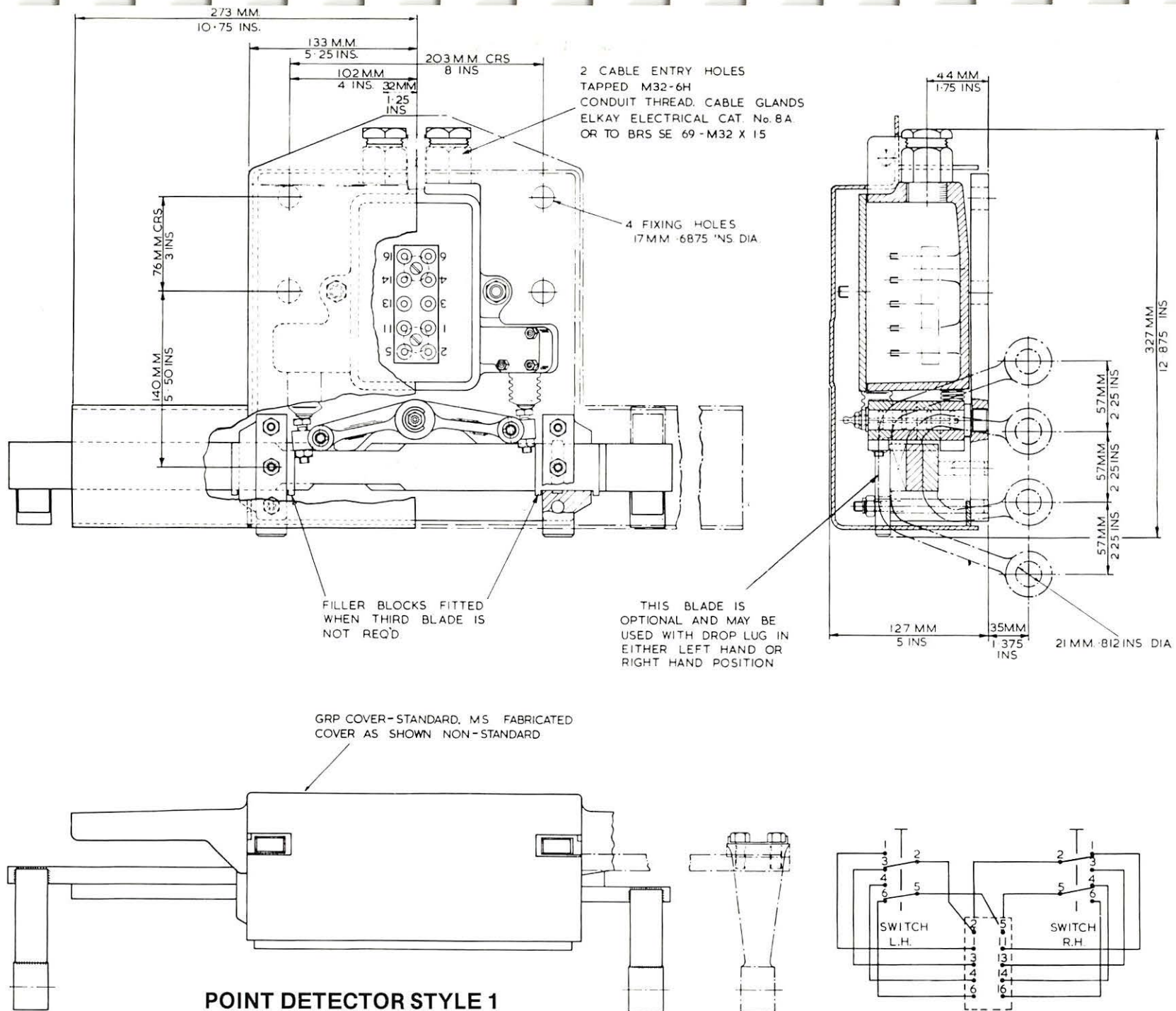
All terminals, nuts and washers are 2BA to BS. 57.

There are two cable entry holes each tapped M32 in the rear of the terminal box, and fitted with electrical cable glands to BRS. SE. 69.

A circuit diagram is attached to the inside of the overall sheet steel or G.P.R. cover.

Finish

The point detector is painted aluminium all over. The G.P.R. cover is light grey.



Outline Drawing

The data contained in this leaflet is as accurate and up to date as reasonably possible. Since it is our policy to be continually reviewing designs, it is possible that current equipment may vary slightly from that described.

Ordering Procedure

Standard alternatives are shown in brackets and should be substituted for the relevant portion of the standard arrangement as required. Optional extras must be specified at time of ordering and a list of required extras should be added under the standard ordering procedure.

Standard Ordering Particulars

M.L. STYLE 1.

An electric 2-blade (3-blade) British Railways Board Standard point detector to British Railways Board Specification 998B.

M.L. STYLE 2.

As Style 1 but stroke 110 to 150 mm.

Optional Extras

1. Padlock.
2. Mounting bracket for external mounting only.
3. Set of Stretcher bars, switch extension pieces and detector rods for external mounting 2-blade.
4. Set of Stretcher bars, switch extension pieces and detector rods for external mounting 3-blade.
5. Set of Stretcher bars, switch extension pieces and detector rods for internal mounting 2-blade.

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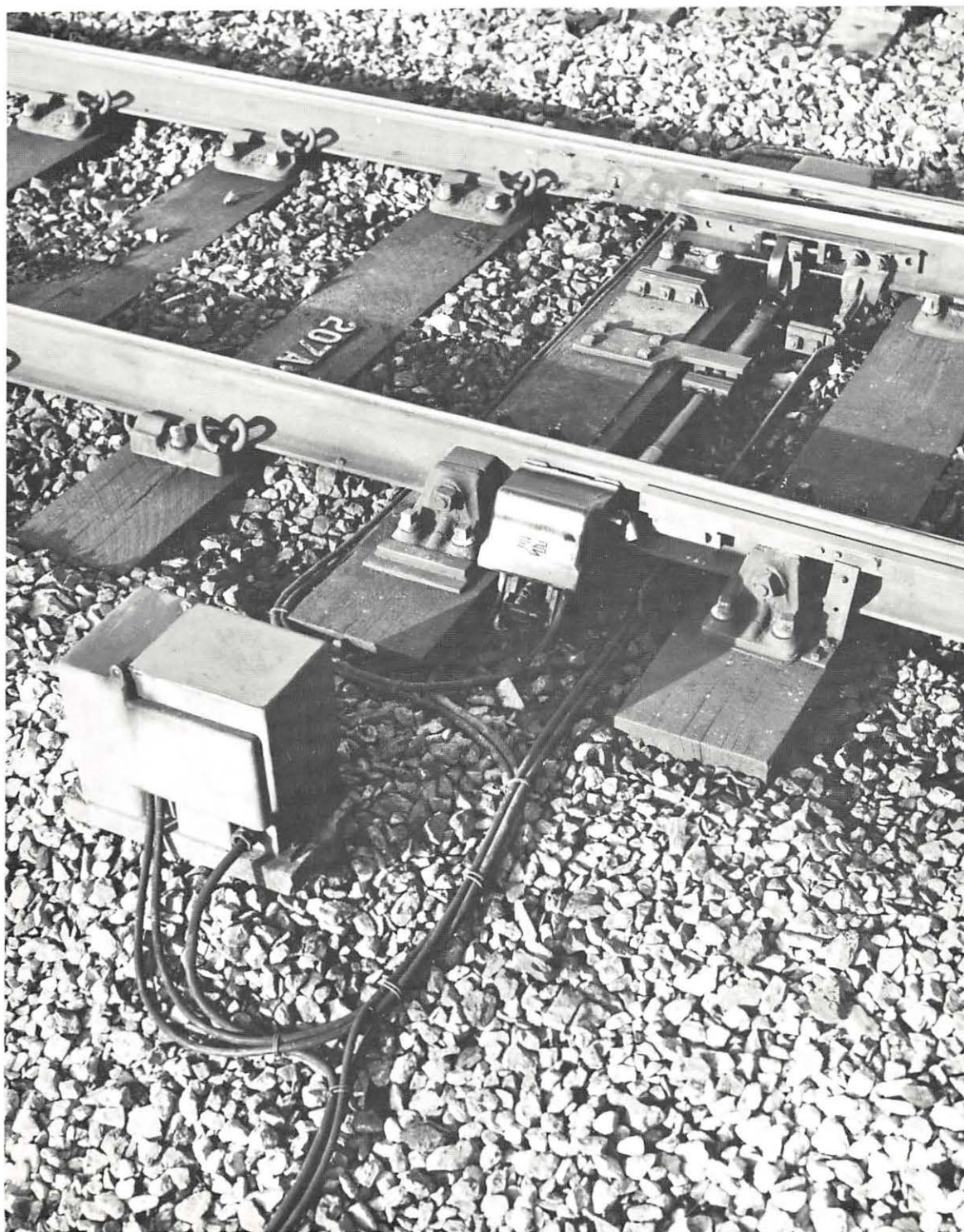
Telephone: Plymouth (0752) 702525 Telex: 45662 Cables: ELECEMEL Plymouth





RAIL CLAMP POINT LOCK

A BRITISH RAIL DESIGN-MANUFACTURED AND
SOLD BY AGREEMENT WITH THE BRITISH RAILWAYS BOARD



TYPICAL POINT CLAMP LOCK LAYOUT.

THE RAIL CLAMP POINT LOCK

THE RAIL CLAMP POINT LOCK has been designed by British Rail as a means of driving, locking and detection of switch rails on various types of railway points layouts. It is an alternative to the more conventional electro-mechanical and electro-hydraulic point machines and is now a standard device on British Railways.

The British Rail Clamp Lock can be applied to facing points, single slip, double slip and switch diamond point layouts.

SPECIAL FEATURES:-

- Low overall cost.
- Protects against loss of lock & detection due to gauge spread.
- No extended timbers or extended soleplates needed.
- Identical clamp locks for both sides of track.
- Low weight and ease of handling.
- Less maintenance than more conventional point-machines.
- Convenience of positioning hydraulic power pack relative to the points.
- A minimum of trackside space required.
- Electric detection using sealed weatherproof limit switches.
- Superior control by electro-hydraulic power pack.
- Typical operation time of 2.5 seconds.
- Alternative manual operation.

TECHNICAL DESCRIPTION

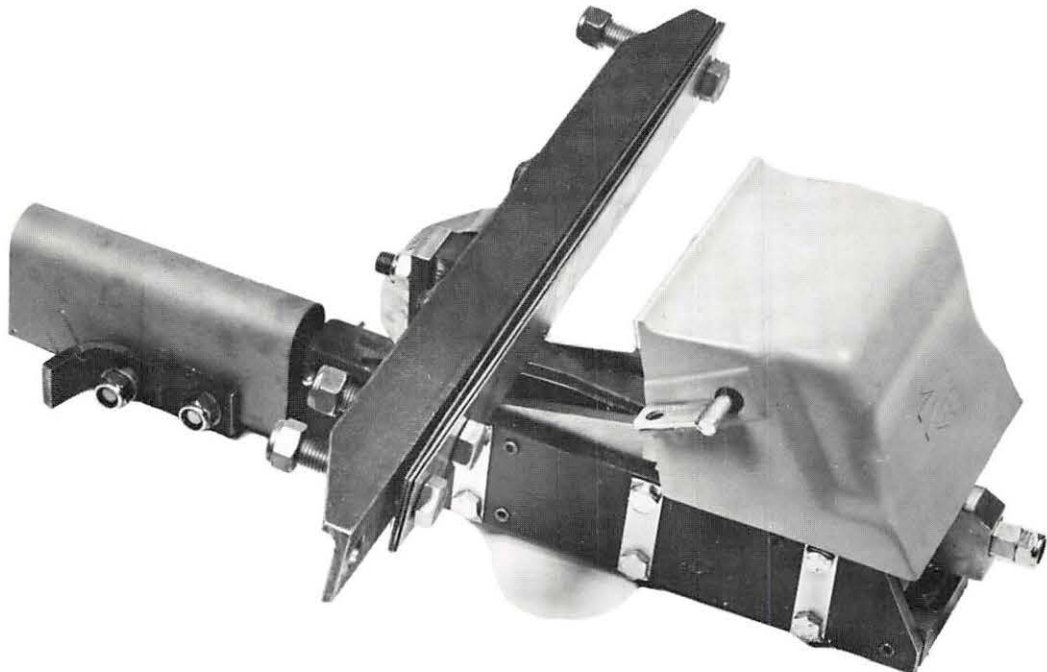
Existing designs can accommodate 109FB, 110FB and 113FB track with vertical or inclined stock rails. 95RBH track can also be accommodated.

The Rail Clamp Lock is initially available for use on railway track of B.R. Standard Gauge having point rails coupled with stretcher bars and for types of points from A to G inclusive. It will, however, function on points on which the point rails are not coupled as under these conditions the mechanism will unlock should the points be trailed.

For applications other than standard gauge and rail sections mentioned above, some modifications are necessary and we would be pleased to offer proposals on receipt of track details.

For movement, locking and detection of a pair of switch rails, two clamp locks, a drive coupling bar and two single acting hydraulic actuators with a power pack are required. Each clamp lock is attached to the associated stock rail and comprises a lock body unit which incorporates a drive lock slide and electric detection.

A bracket carrying a lock arm and point detector blade is attached to each switch rail. The general installation arrangement is shown in Fig. 1.



LOCK AND DETECTOR ARM ASSEMBLY

SWITCH OPEN

SWITCH CLOSED

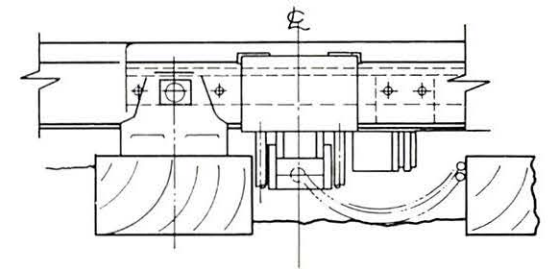
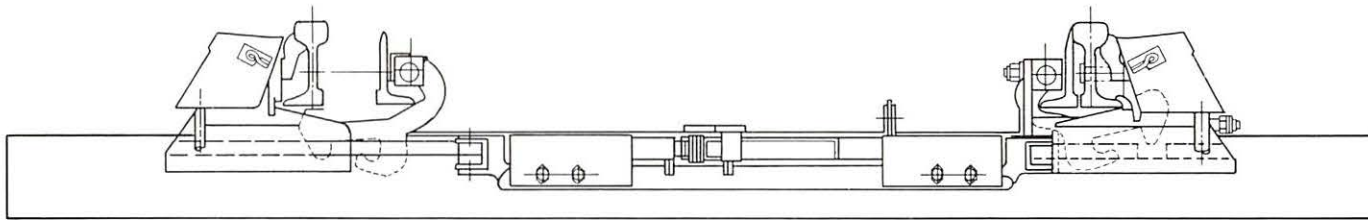
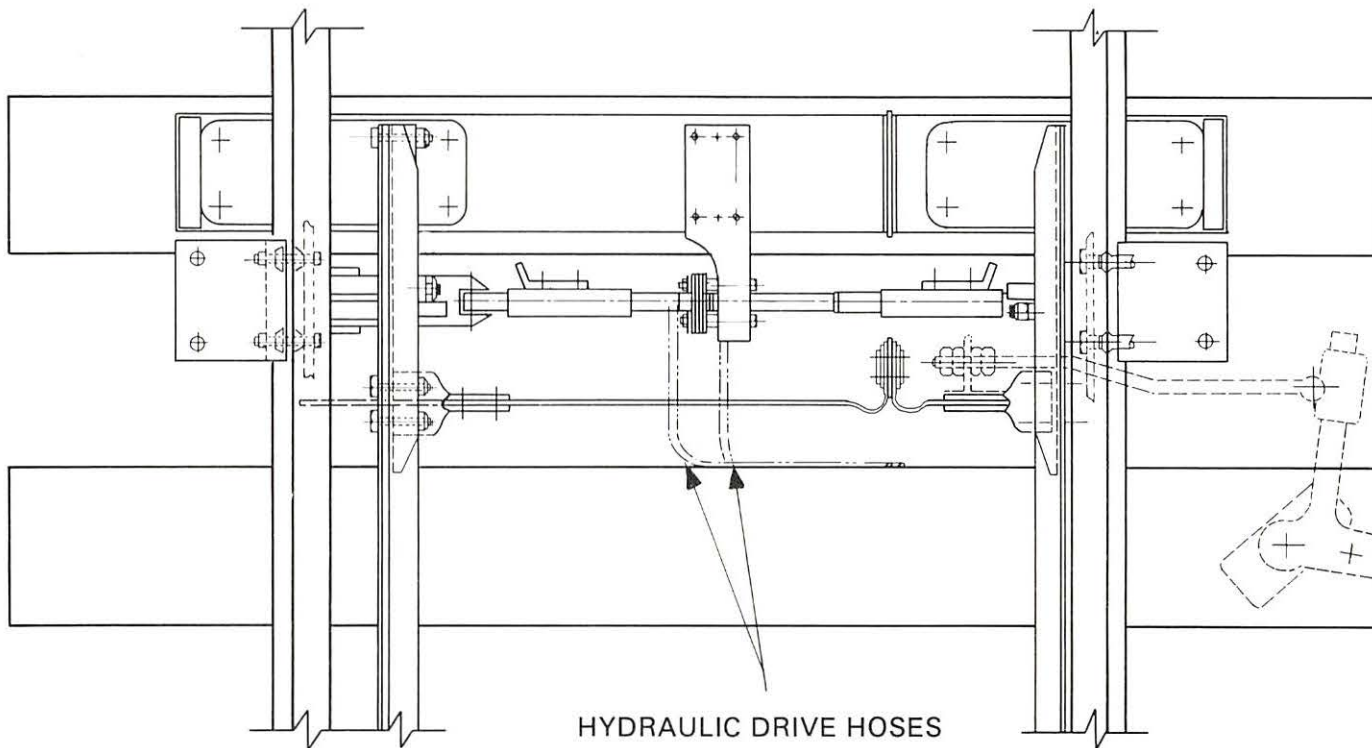


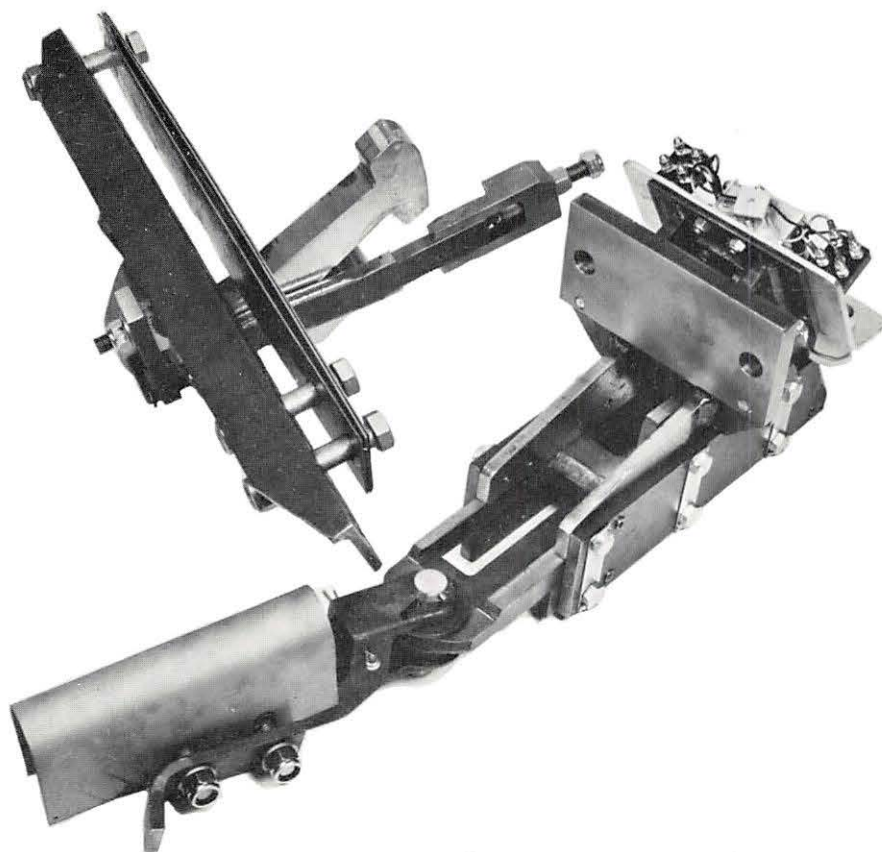
Fig.1. RAIL CLAMP INSTALLATION.

LAYOUT SHOWN FOR 113A FB VERTICAL TRACK
 Use appropriate adaptor block assemblies
 and the same equipment can be fitted to:-
 Vertical FB track 110 and 113
 Inclined FB track 110 and 113
 Inclined BH track 95R



HYDRAULIC DRIVE HOSES

MECHANICAL DRIVE



LOCK AND DETECTOR ASSEMBLIES.

MODE OF OPERATION

This is illustrated in Fig. 2. A drive lock slide supported from the stock rail and working below sleeper level is driven against a hook shaped lock arm pivoted from the switch rail arranged to swing vertically and to pass under the associated stock rail. When the switch rail is fully closed the lock arm lifts behind the stock rail to clamp and lock these rails firmly together. A coupling bar between the drive lock slides pulls on the opposite side to release that lock and retain the adjacent switch rail in the open position.

For each clamp lock, electric detection of the switch rail and drive lock slide is effected by double pole sealed limit switches. The "switch closed" contacts can make only when the two linear cams, one on the switch detection blade and one on the drive lock slide, are in the correct position. The "switch open" contacts can only make when the cam on the switch detector blade has moved to a position corresponding to minimum switch opening.

HYDRAULIC POWER PACK AND ACTUATORS

British Rail electro-hydraulic Power Packs and Actuators complying with B.R.B specification BR 817 would be supplied as standard.

The equipment is of robust design and finish to withstand a trackside environment and is designed for the minimum of maintenance attention. It is arranged for mounting by means of four studs on a concrete or similar robust base.

Principal components consist of the electro-hydraulic power pack, hoses, a centre thrust bracket and two single acting hydraulic actuators. The power pack is a self-contained unit comprising an oil reservoir with pump and integral electric d.c. motor, hand lever pump, control valves, connections for two oil line hoses and a cut-out switch for isolating the power unit when operating the equipment manually by the hand lever pump. The centre thrust bracket is located on the first sleeper from the switch toes on the "centre line" of the track and carries the ends of the hydraulic cylinders in opposed spigot locations. Each hydraulic ram piston rod is connected in line with a drive lock slide. The power pack is enclosed in a robust cast alloy weatherproof box with hinged cover secured by a padlock.

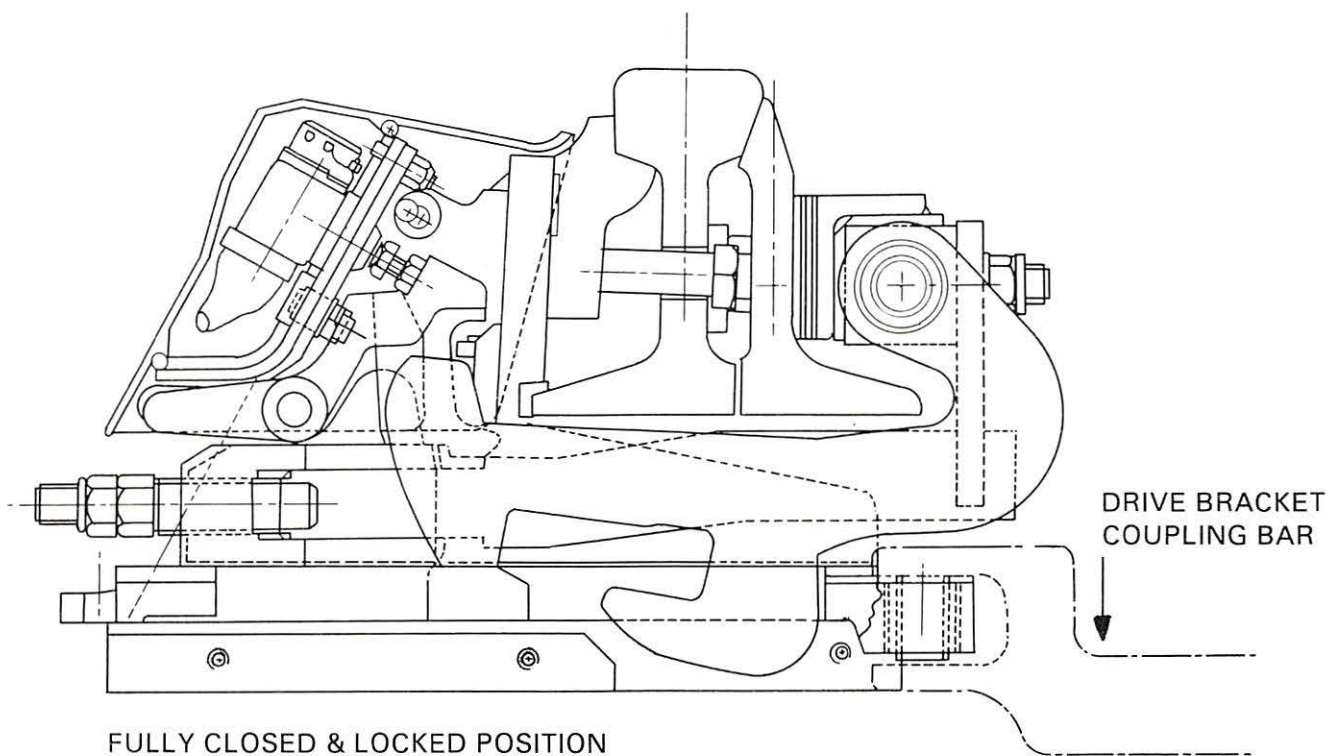
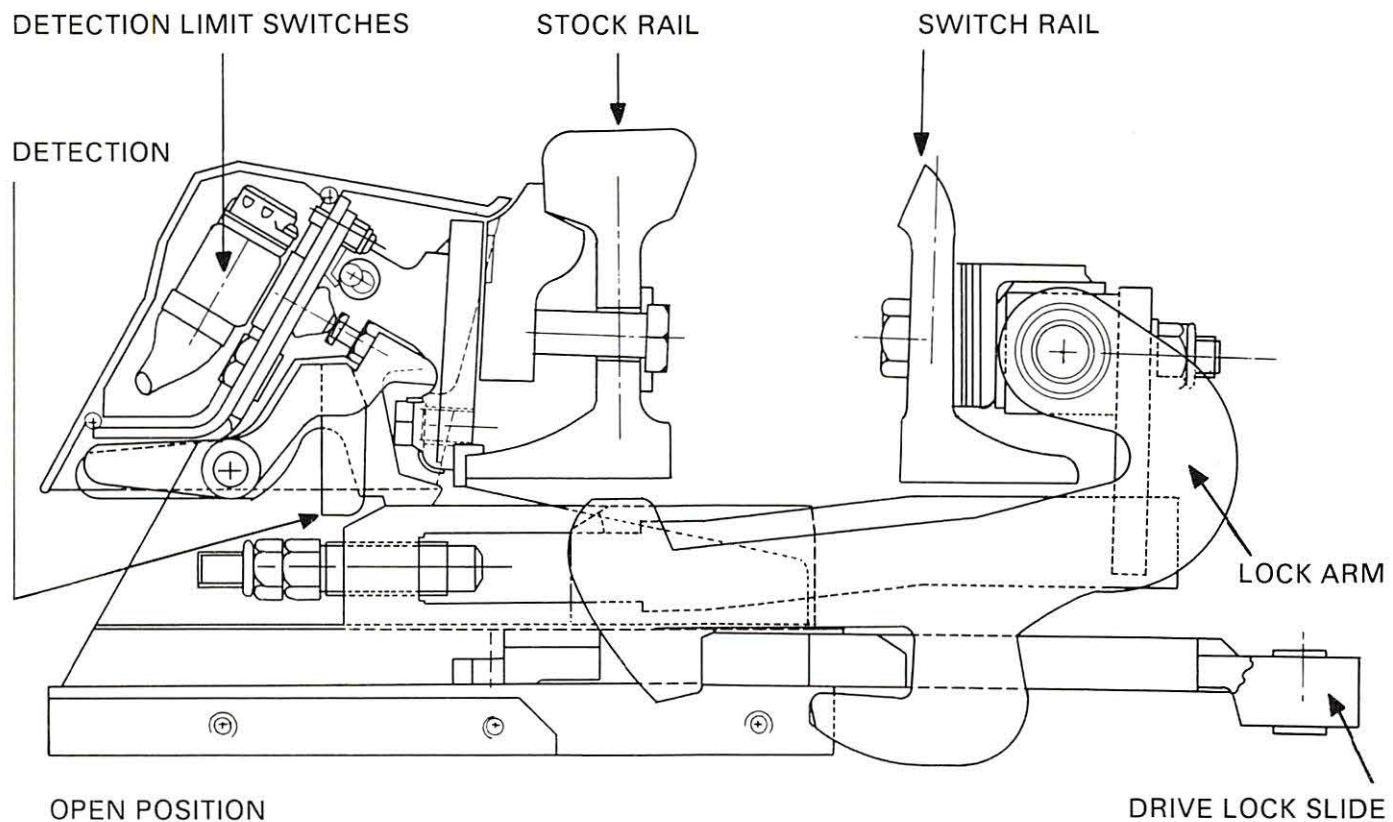


Fig.2. RAIL CLAMP LOCK - OPERATION MODES.

HYDRAULIC POWER PACK AND ACTUATORS (CONT'D)

The power pack can be positioned on the track side at any convenient position, usually within a radius of 7 metres of the clamp locks.

Two voltage ratings can be provided as standard;

Type HV110 - Basic Standard Operation 110 volts d.c.

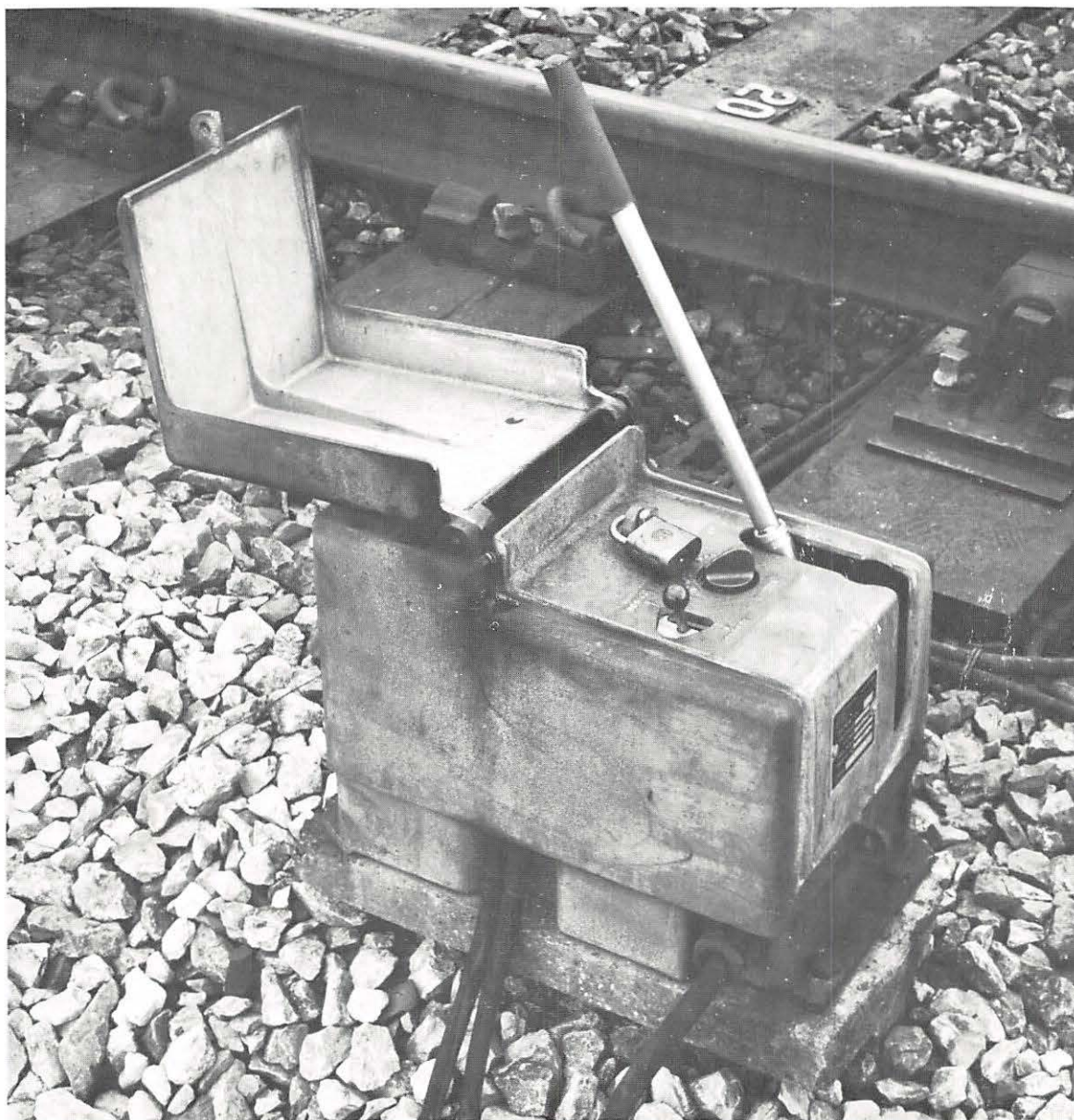
Type LV50 - For Special Applications 50 volts d.c.

Only the HV110 is immune to operation from an a.c. source (nominal max 600 volts 50Hz). Unless otherwise requested, a type HV110 would be supplied. In the event that other supply voltages are preferred, please provide full details so that appropriate proposals can be made.

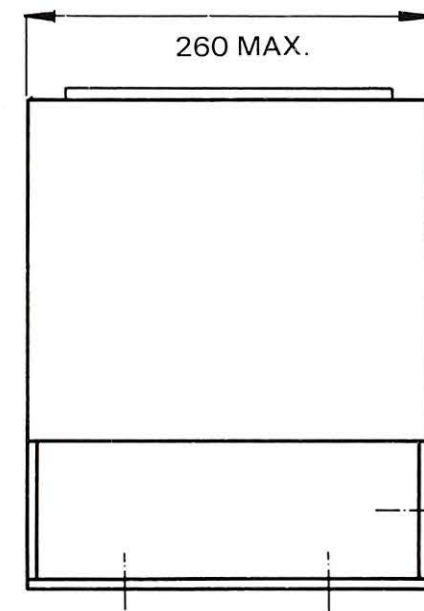
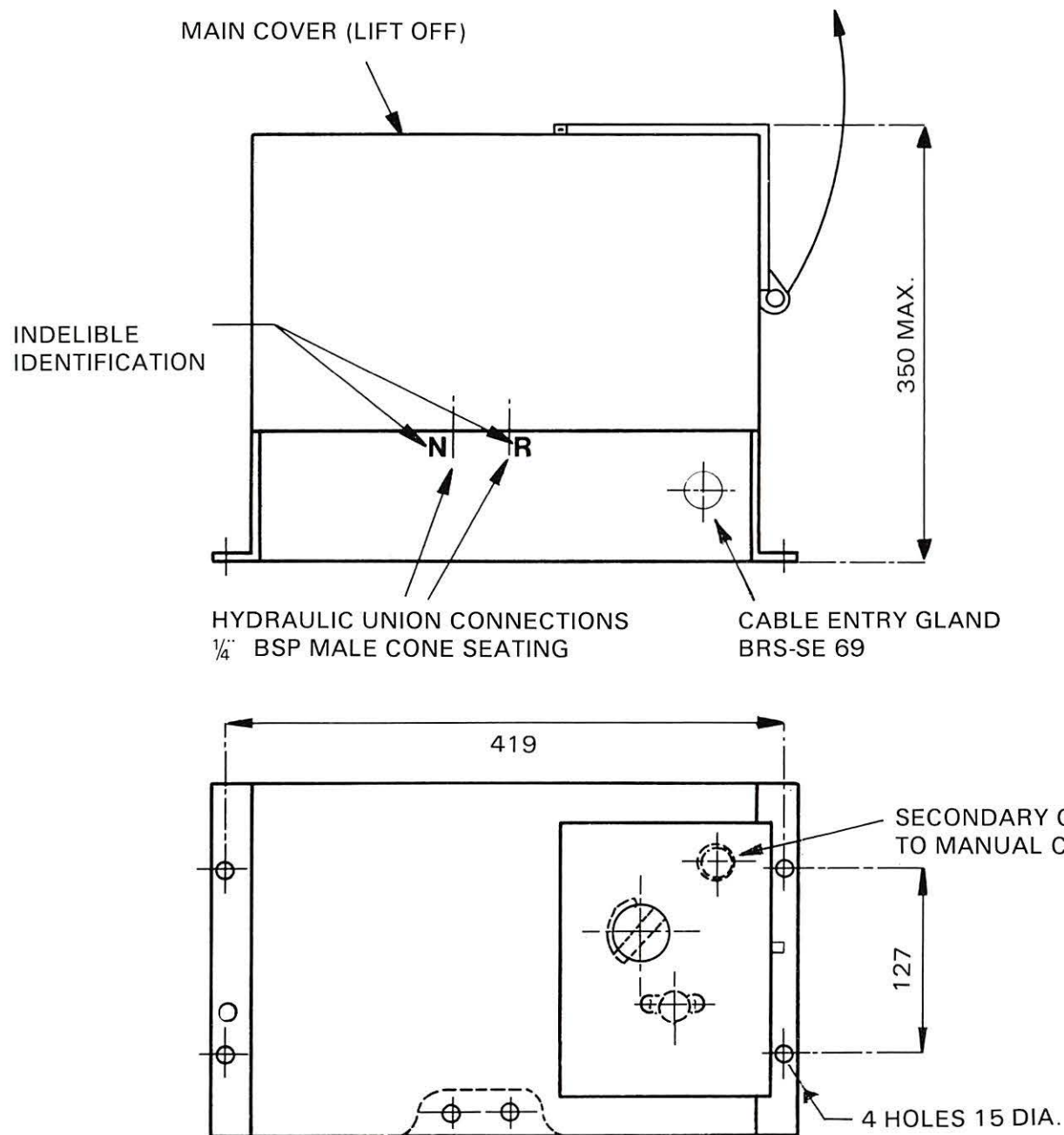
The machine may be operated "manually" at any time by use of a hand pump for which a separate lever is provided. An electrical cut-out switch provides the necessary interlocking between the electrical drive and the manual hydraulic pump. In an emergency it is also possible to lever the switch points over with a bar with the aid of lugs provided for the purpose.

INSTALLATION

Complete details giving dimensional positions for the installing the rail clamp locks and associated equipment, rail drillings, etc., will be supplied for each point layout.

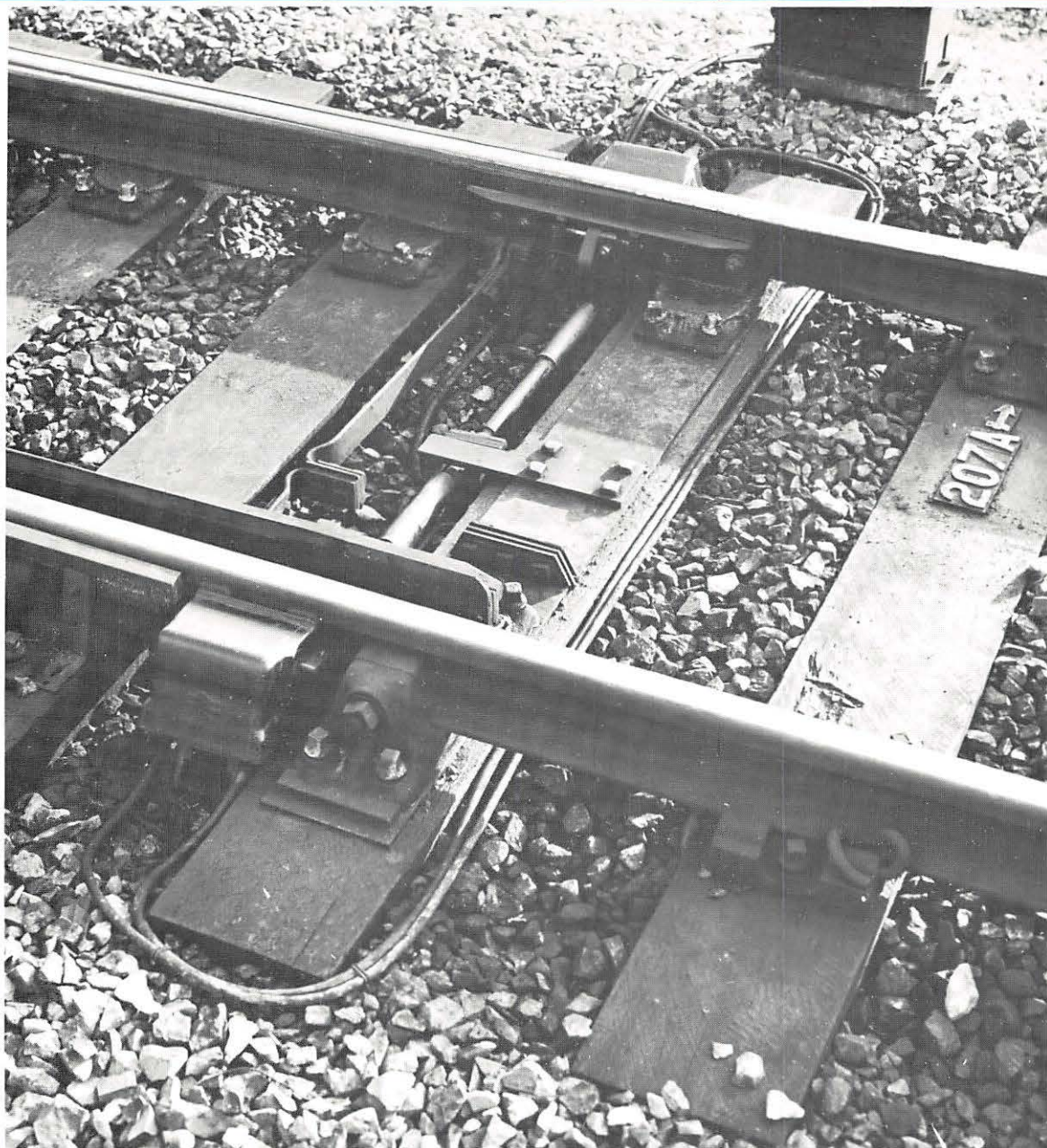


**HYDRAULIC POWER PACK WITH HAND PUMP.
POSITIONED FOR 'MANUAL' OPERATION.**



DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

**Fig.3. HYDRAULIC POWER PACK
OVERALL DIMENSIONS.**



The information contained in this brochure describes the British Rail Standard Equipment. Adaptions are possible for other gauges and/or rail sections and we would be pleased to submit proposals to meet your special needs.

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ORDERING PROCEDURE

Unless otherwise requested a complete set of clamplock equipment for British Rail Standard Gauge (1435mm) and for 110 volt d.c. operation for use in a U.K. enviroment will be supplied. A set would comprise:-

- Lock and Detector Mechanism Assemblies.
- Adaptor Block Assemblies.
- Lock and Detector Arm Assemblies.
- Taper Packing.
- Tie Bar.
- Centre Thrust Bracket.
- Drive Lug.
- Electro-Hydraulic Power Pack and Connecting Hoses.
- Hand Pump Lever.
- Displacement Rams.

PLEASE PROVIDE THE FOLLOWING INFORMATION WHEN ORDERING:-

1. Complete details of the Point Layouts
2. Track Gauge.
3. Rail Section.
4. Drive Actuators if other than hydraulic.
5. Voltage and type of Electrical Supply.
6. Enviromental Conditions.

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Location Cases



Location Cases

Location Cases are generally situated at the track side and are intended for housing relays, transformers, transformer/rectifiers, track feed sets, cable terminations and other equipment. An equipment mounting rack is supplied as standard and fits inside the case.

Special Features

- Easily-removable equipment racks for pre-wiring and testing to be completed in the factory.
- Removable sides, roof and rear panels (if fitted) for easy maintenance.
- Dustproof cases available as optional extras.

Type of Location Case

Location cases are available either as four-door assemblies with front and rear access or alternatively as two-door assemblies with front access only.

Two case sizes are available differing only in the height. Sizes are 1,981mm. (78") and 1,372mm. (54") high respectively and 1,086mm. (42 3/4") wide x 590mm. (23 1/2") deep.

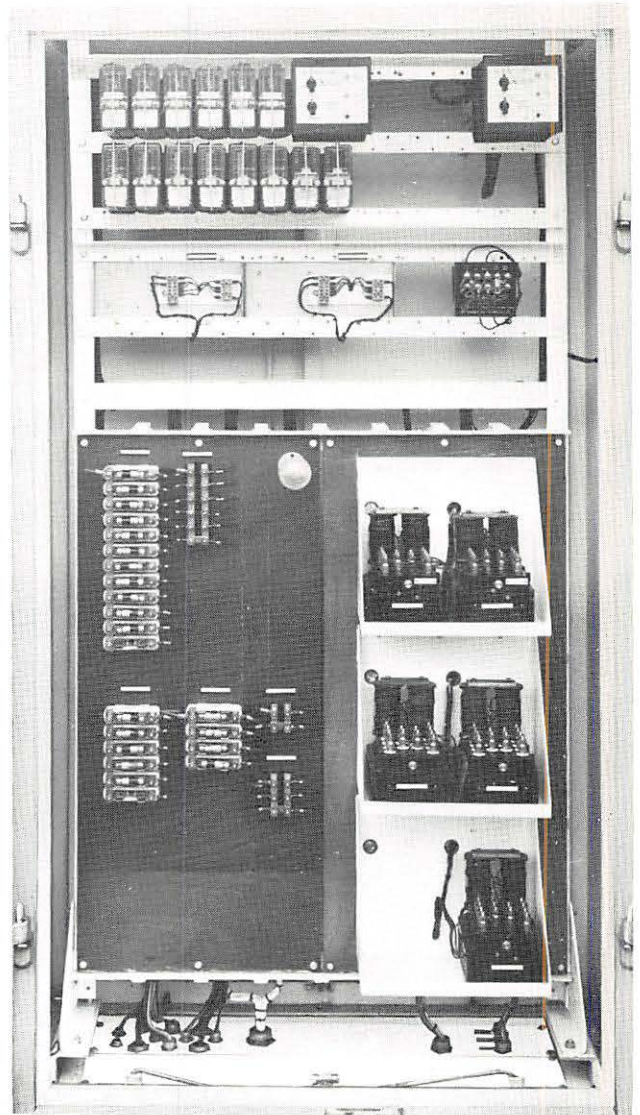
Case

The case consists of upper and lower mild steel angle frames to which are welded or bolted sheet steel side panels. A ridge type steel roof panel is bolted to the upper frame. Doors are attached with strap hinges which allow the door to be lifted off for maintenance.

Two-door cases have a steel panel substituted at the rear. Each door can be restricted to 90° opening by stays located in the base of the case. Removal of the stay permits opening to 180°. The doors are held closed by means of a lever arm and 3-way van door lock assembly fitted to the right hand door. The exterior handle permits both doors to be padlocked on the exterior. As an optional extra doors can be fitted with expanded neoprene seals for dustproof conditions.

Mild steel lifting lugs are welded at the upper end of each side panel with lug holes of 20.6mm. (13/16") diameter.

The base of the case contains four 16mm. (5/8") diameter holes on a 610mm. (24") x 387mm. (15 1/4") grid for fixing the case to a base.



Equipment Rack

The location rack is a mild steel angle frame which is bolted to the upper and lower frame of the location case. Alternative base mounting brackets for the rack are available and determine the depth of mounting position within the location case. The rack can easily be installed on site.

Two sizes of rack are available differing only in height. Normal dimensions are 178mm. (70 1/8") and 1,172mm. (46 1/8") high respectively and 956mm. (37 5/8") wide. Wooden backboards 16mm. (5/8") thick resin bonded plywood, Post Office relay mounting plates, terminal mounting rails, equipment for mounting rails and cable trunking all for attachment to the rack are available as optional extras.

Mounting

Cases are normally bolted to a concrete base. A steel base plate 1,076mm. (42 3/4") long x 508mm. (20") wide with easily removable mild steel gland and inspection covers is available as an optional extra.

Finish

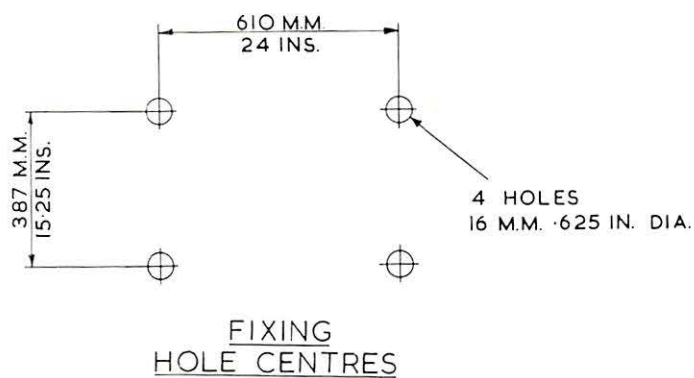
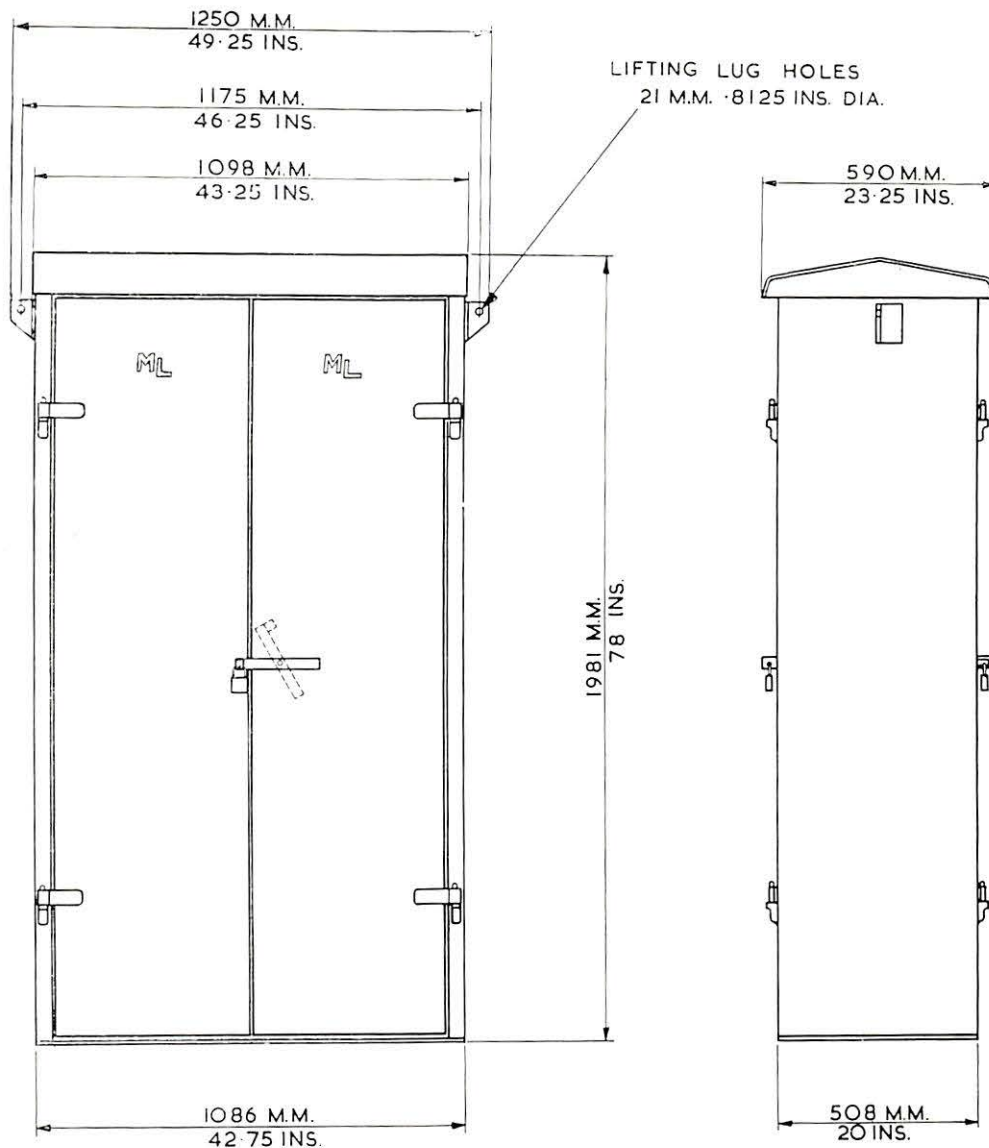
The interior of the case and rack is painted white with aluminium on the exterior or is available as an optional extra with any other paint finish that may be specified. The standard paint finish is as follows.

Case Interior and Rack

Descale, degrease and phosphate surface, primed with red oxide, two undercoats and one final coat of white paint.

Case Exterior

Descale, degrease and phosphate surface, primed with red oxide of iron with two final coats of aluminium paint.



Ordering Particulars

Standard alternatives are shown in brackets and should be substituted for the relevant portion of the standard arrangement as required. Optional extras must be specified at time of ordering and a list of required extras should be added under the standard ordering procedure.

Standard Ordering Particulars

Location Case 1,981mm. (78") high fitted with 4 doors (2 doors) and central (recessed) equipment rack.

Location Case 1,372mm. (54") high fitted with 4 doors (2 doors) and central (recessed) equipment rack.

Optional Extras

1. Padlock(s).
2. Paint finish to be specified.
3. Set of neoprene gaskets for 1,981mm (78") 4-door case.
4. Set of neoprene gaskets for 1,981mm. (78") 2-door case.
5. Set of neoprene gaskets for 1,372mm. (54") 4-door case.
6. Set of neoprene gaskets for 1,372mm. (54") 2-door case.
7. Steel base plate with felt joint, gland and inspection covers.
8. Wooden back board 997mm. (39 1/4") x 457mm. (18") for 1,981mm. (78") high case.
9. Wooden back board 921mm. (36 1/4") x 337mm. (13 1/4") for 1,372mm. (54") high case.
10. Post Office relay mounting plate 127mm. (5") x 57mm. (2 1/4") to mount Keyswitch type relay in one B.R.B. standard relay space.
11. Terminal mounting rail 1,003mm. (39 1/2") long for 48 2BA terminals.
12. Terminal mounting rail 1,003mm. (39 1/2") long for 37 0BA terminals.
13. Top or bottom equipment mounting rail 921mm. (36 1/4") long, drilled to take 14 B.R.B. standard relays.
14. Middle equipment mounting rail 921mm. (36 1/4") long drilled to take 14 B.R.B. standard relays.
15. Top cable trunking 927mm. (36 1/2") long.
16. Middle cable trunking 927mm. (36 1/2") long.
17. Bottom cable trunking 927mm. (36 1/2") long.

The data contained in this catalogue is as accurate and up to date as reasonably possible. Since it is the policy of the Company to be continually reviewing designs, it is possible that current equipment may vary slightly from that described.

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ML

Style T.I. 21 Jointless Track Circuit



Typical T.I. 21 Transmitter

The M L Audio Frequency Jointless Track Circuit Style T.I. 21 is designed for use in areas where there is A.C. or D.C. electrification and where high values of interference signals may be present. In meeting these extremely onerous requirements the equipment meets the need of all known track circuits, hence it is classified as a universal type. Audio frequencies are used, typically in the range 1500 to 2600 HZ. The track circuit operates on a frequency shift principle, where the carrier frequency is shifted between two frequencies close to each other. Both these frequencies are detected independently and a number of other checks are performed to ensure very high security against false operation.

INTRODUCTION

The T.I. Track Circuit Style 21 is of the Jointless type designed for A.C. or D.C. electrified areas where high levels of interference (arising principally from 50 Hz harmonics) may be present. The equipment classified as universal since it meets the onerous immunity requirements of all traction systems and the needs of all known track circuits.

Audio frequencies in the range of 1.5k Hz to 2.6k Hz are used and eight types of track circuit are provided, each operating at a unique pair of frequencies. This enables two types to be used per track for up to four parallel tracks.

Modulation is included so as to provide security and to enable information to pass along the track circuit and be collected at a track side or at a train borne receiver.

For applications where the variable modulation rate facility is not required a version of the track circuit is available with the modulation rate fixed at 4.8 Hz.

A block diagram of the basic track connection layout is depicted in Fig. 2. Special configurations may also be adopted for centre fed arrangements and for terminating the T.I. track circuit adjacent to an insulating rail joint.

Impedance bonds are available for connection across the running rails, outside the tuned area, so as to equalise the traction return current. These are tuned to resonance at the track circuit frequency by means of a separate tuning unit, thus minimizing the loading effect of the track circuit. The bonds also feature a centre tap connection for rail to rail and substation connections. Other arrangements are available for low voltage D.C. electrification systems.

Standard B.R.B. miniature relays to B.R. Specification 930A may be directly operated by the receiver, thus avoiding the use of low powered high percentage release relays with small contact stacks. Slow to energise repeat relays are not normally necessary due to the slow to energise feature of the receiver.



RECEIVER

A block diagram of the receiver is shown in Fig. 4. The signal from the track tuning unit is fed to the input transformer (1) which is used to isolate the receiver circuit from the track, and to pre-set the receiver gain. Protection from the effects of common mode interference is provided by means of an interwinding earth screen.

The signal is filtered at 2a which is tuned to the higher carrier frequency and at 2b which is tuned to the lower carrier frequency. Each of the resulting two signals is then amplified at (3), further filtered at (4) and de-modulated at (5).

The two demodulated outputs are combined in a special sequential "and" gate at (6) and the resulting signal is then presented to the input of a timing circuit (7). This circuit will produce an output after a pre-determined time delay so as to ensure that even at the slowest rate of modulation both low and higher frequency carrier signals are received. This timer also features a very fast re-set time so that if either input is removed, even for a very short period, the timing cycle will be recommenced. The output from the timer goes to a relay drive circuit (8) which operates the relay.

TRANSMITTER

A block diagram of the transmitter is shown in Fig. 3. A modulator (1) produces a modulating frequency in the range 2 to 8 Hz, dependent upon external connections. When a connection is made between terminals (6) and (7), for example, a modulating frequency of 8.0 Hz is produced. This signal modulates the output of the oscillator (2) and so produces a signal frequency modulated at 8 cycles per second.

Amplifier (3) amplifies this signal to a power level suitable for transmission down the track. Special design features are included to provide an output impedance so as to ensure a suitable shunt value for the track circuit as a whole.

Transformer (4) provides a means of matching the amplifier output to the load and filter (5) serves to isolate the unit from unwanted A.C. and D.C. currents from the track.

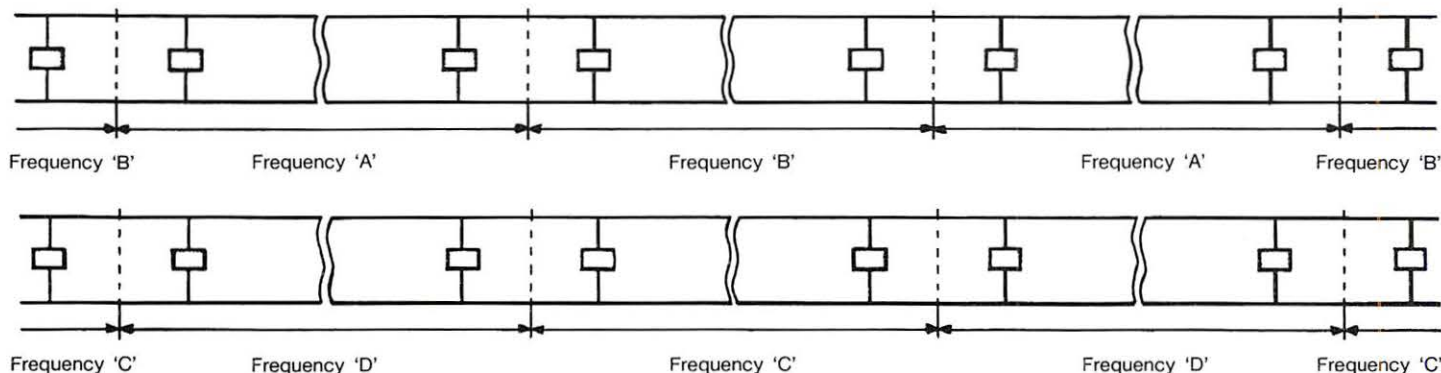
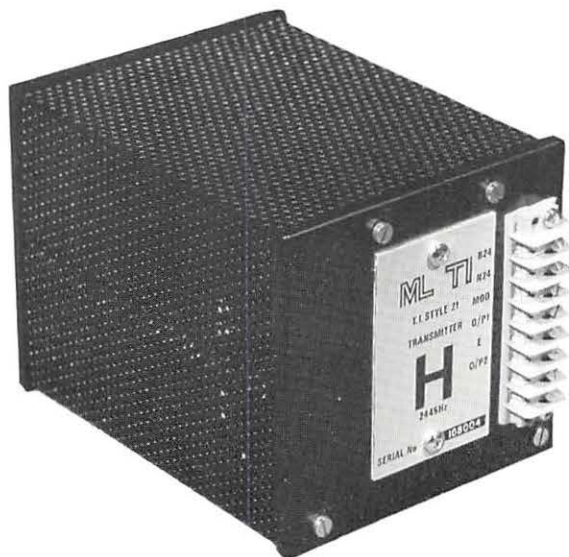
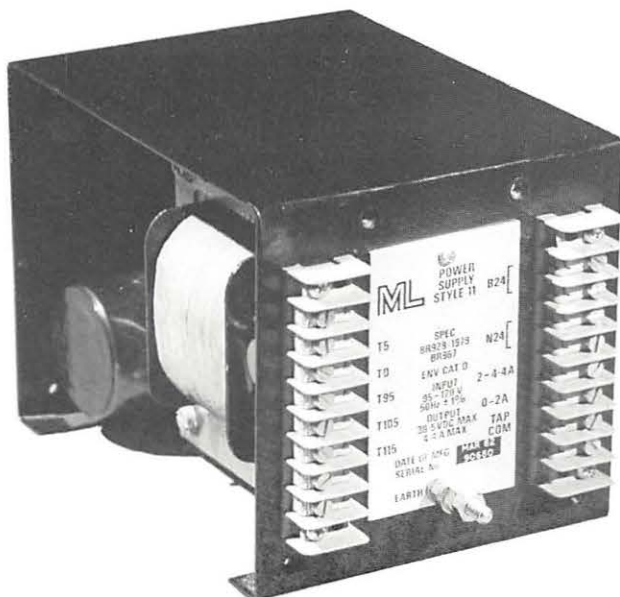


Fig. 1. — Typical Frequency Layout for T.I. Jointless Track Circuit — For two lines

THE ELECTRONIC JOINT

The electrical separation of adjacent T.I. track circuits is accomplished by tuning a short length of track using two track tuning units (see Fig. 2.). The tuned length will depend on the track circuit application. For normal applications on standard gauge track the tuned length is 20 metres, with the track circuit carrier frequencies in the range 1600 Hz to 2600 Hz.

Special arrangements are available for centre fed track circuits and for termination adjacent to an insulated rail joint so as to replace the "missing" tuned length and still ensure continuous train detection.



POWER SUPPLIES

Both the transmitters and the receivers require a D.C. power supply of 24 Volts (nominal) for satisfactory operation. The design has been deliberately engineered so as to avoid the need for a solid state regulated unit.

The power supply unit which is available for this application complies with B.R. Specification 929 and is rated for a maximum output of 4.4A thus permitting up to two transmitters to be powered from one unit. The power supply unit features a high level of smoothing achieved by the use of very high quality long life electrolytic capacitors.

MOUNTING ARRANGEMENT

Transmitter, receivers and power supply units are all designed for mounting direct onto relay racks which are pre-drilled with clearance holes for mounting standard miniature signalling relays in the B.R.B. 930 series. All three units may be mounted on either the front or on the rear of the rack and have female threaded inserts correctly spaced for this purpose.

All three rack mounting units feature terminal blocks and appropriate labelling on the front face. The external wiring may be connected via a special terminating strip so as to reduce changeover times and ensure that the correct connections are maintained. The labels for transmitters and receivers are colour coded so as to identify their frequency and this is further emphasised by the incorporation of the frequency letter code.

Track tuning units are normally mounted on steel posts having their bases buried in the ballast adjacent to the track. They are connected to the rails using special low loss cables, either brazed or crimped to the running rails.

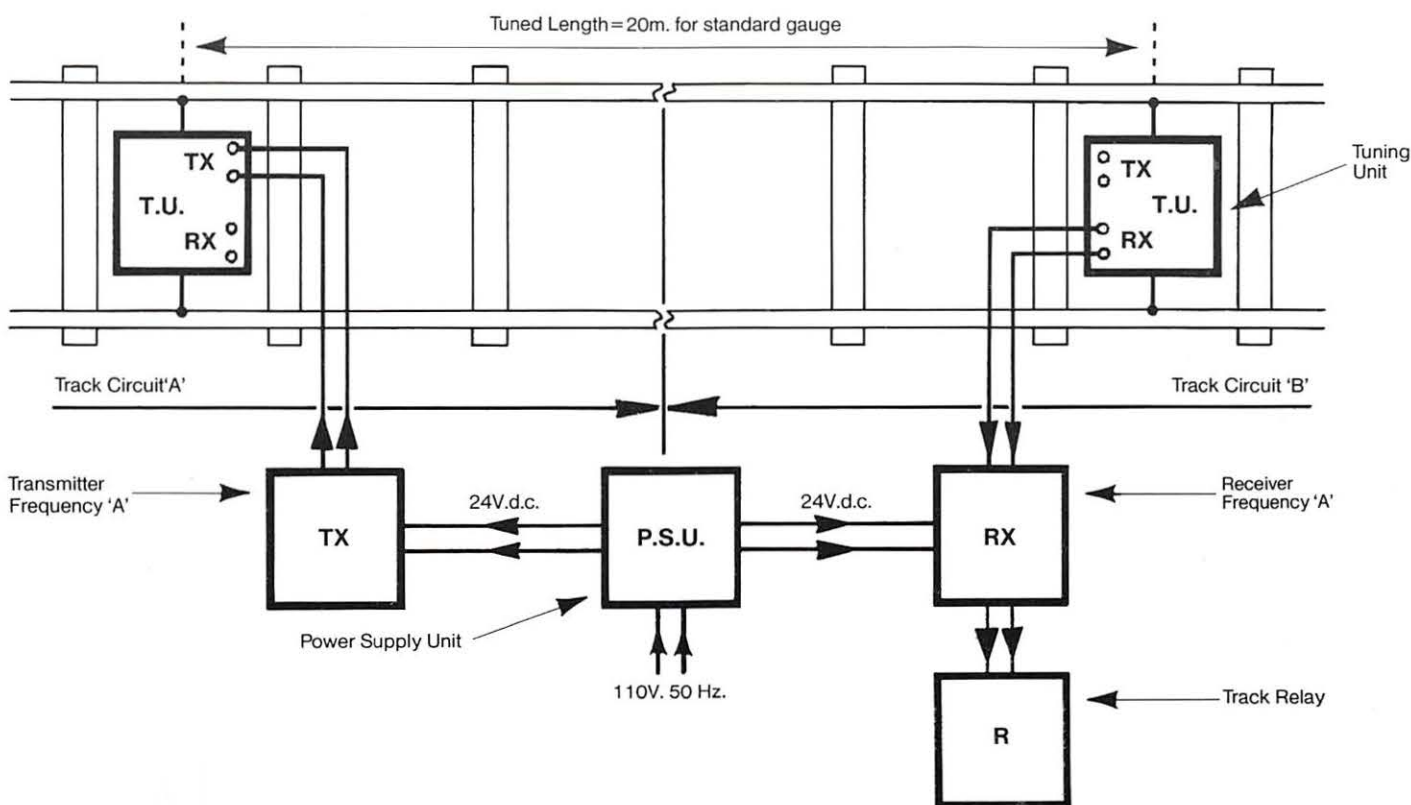


Fig. 2 — The Electronic Joint

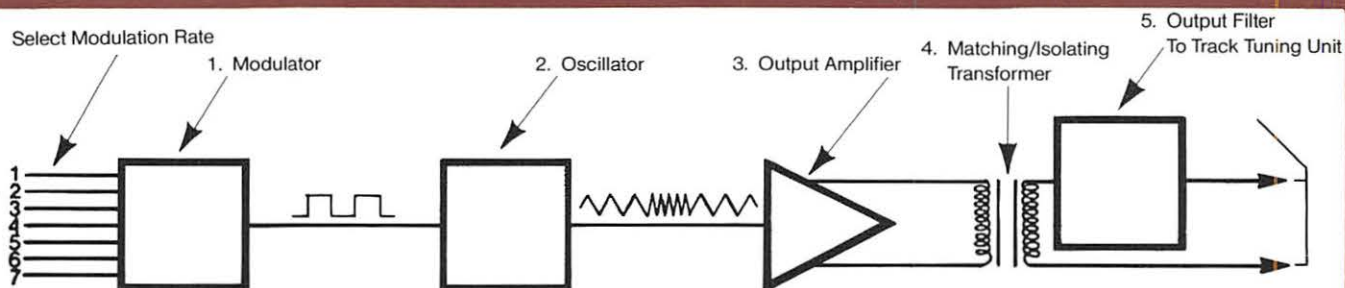


Fig. 3 — Transmitter Block Diagram

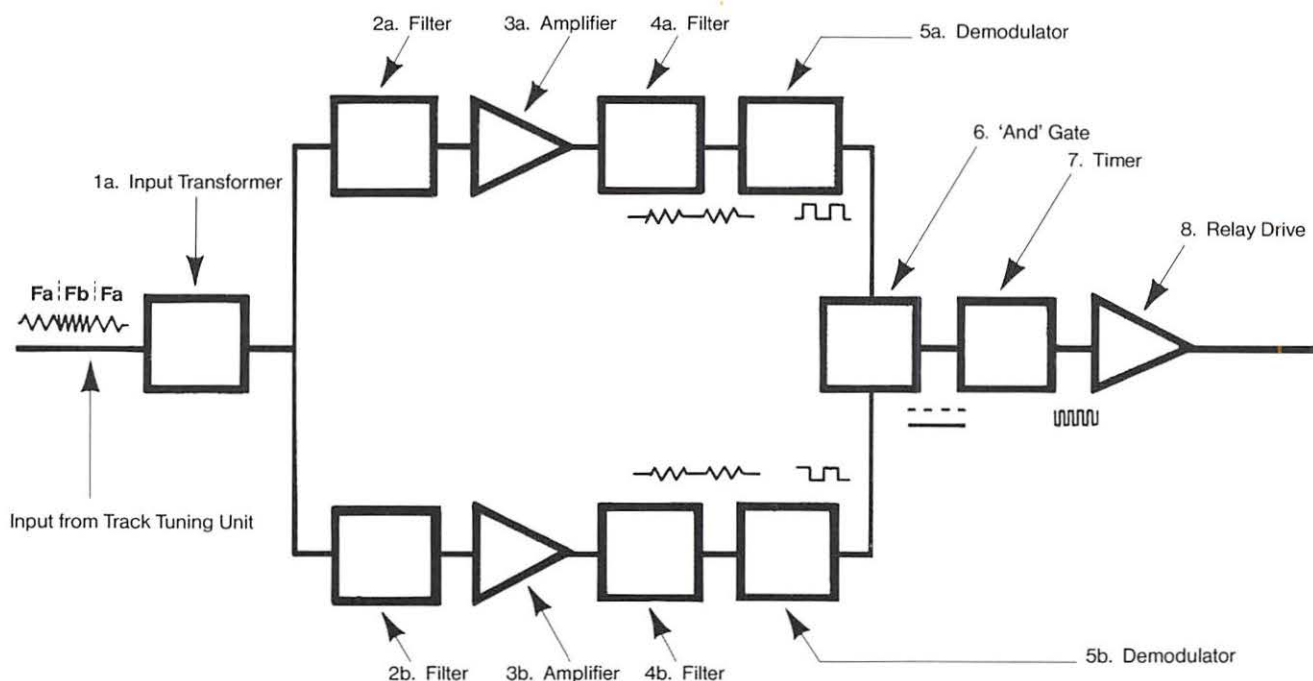


Fig. 4 — Receiver Block Diagram

SPECIFICATION

A. GENERAL

1. Track circuit length:-
50m to 2400m
(dependent upon ballast resistance and track circuit configuration).
2. Tuned length:-
Typically 20m for main line applications.
3. Ballast conductance:-
0.5 Ω /km maximum.
4. Train shunt:-
0.5 Ω minimum outside tuned area.
0.15 Ω minimum within tuned area.
5. Temperature range:-
-30°C to +70°C.
6. Determination of track circuit extremity:- ± 5 metres maximum.
7. Relay:-
B.R. Specification 930A.
8. Track circuit nominal frequencies:-

a) Main line:	A. 1699 Hz	Set 1
	B. 2296 Hz	
	C. 1996 Hz	Set 2
	D. 2593 Hz	
	E. 1549 Hz	Set 3
	F. 2146 Hz	
	G. 1848 Hz	Set 4
	H. 2445 Hz	

B. TRANSMITTER

1. Power consumption:-
2.2A max. over range 22.5V DC to 30.5V DC.
2. Output power:-
40W (max.)
3. Output stabilisation
 $\pm 3\%$ max.

4. Connecting cables to tuning unit:
Loop resistance of 0.5 Ω maximum.
5. Typical modulation rates:
2.2Hz, 2.9Hz, 3.7Hz, 4.8Hz, 6.3Hz, 8.0Hz.
6. Unit size:
140 mm high x 140mm wide x 191mm long (takes space of 2½ BRB miniature relays).
7. Mounting:
Screw fixings arranged for standard BRB miniature relay racks.

C. RECEIVER

1. Power consumption:
0.5A max. over range 22.5V DC to 30.5V DC.
2. Relay output:
50V DC into 1000 ohm (suitable for driving BRB 930A relay).
3. Input cable:
Loop resistance of 10 ohm maximum.
4. Unit size:
As per transmitter.
5. Mounting:
As per transmitter.

D. POWER SUPPLY

1. Input:
110V AC 50Hz with tapings arranged at 5, 0, 95, 105 and 115V.
2. Output:
Between 22.5V and 30.5V with simultaneous load variations between 0.25A and 4.40A and input variations of $\pm 9\%$ about the selected tapping.
3. Mounting:
As per transmitter.
4. Specification:
B.R. Spec. 929.

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ML ENGINEERING
(PLYMOUTH) LIMITED



SUB-CONTRACT
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ML Engineering (Plymouth) Limited is a wholly owned subsidiary company of ML Holdings PLC.

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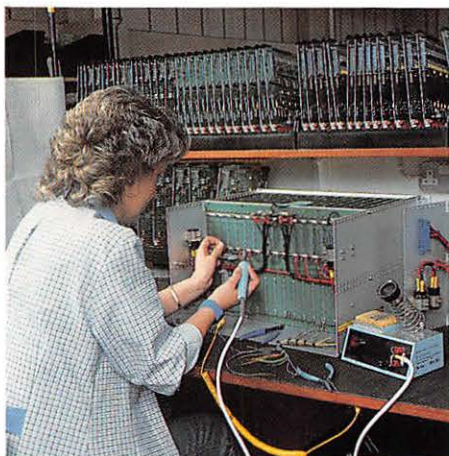
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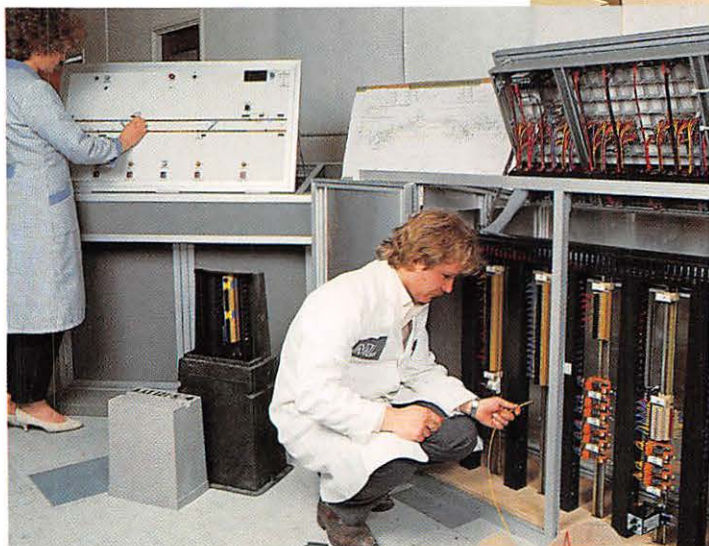
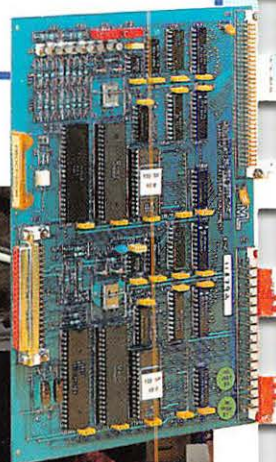
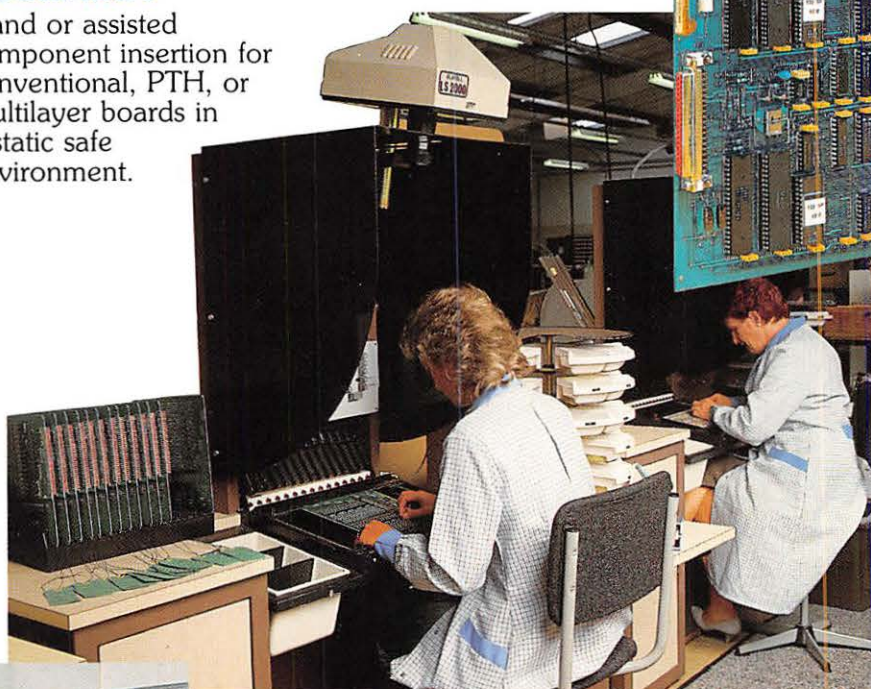


PRINTED CIRCUIT ASSEMBLY

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We undertake assembly of a wide variety of equipment using various levels of skilled labour, from pre-production prototype information to full detailed drawings.



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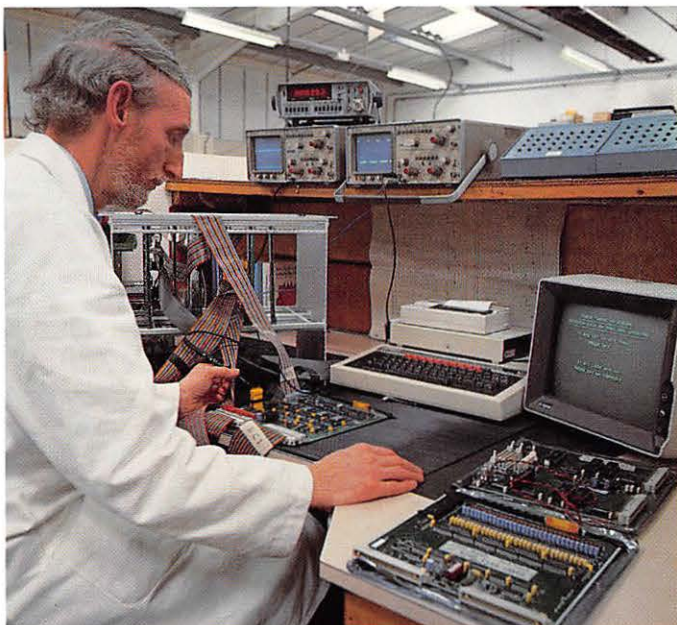
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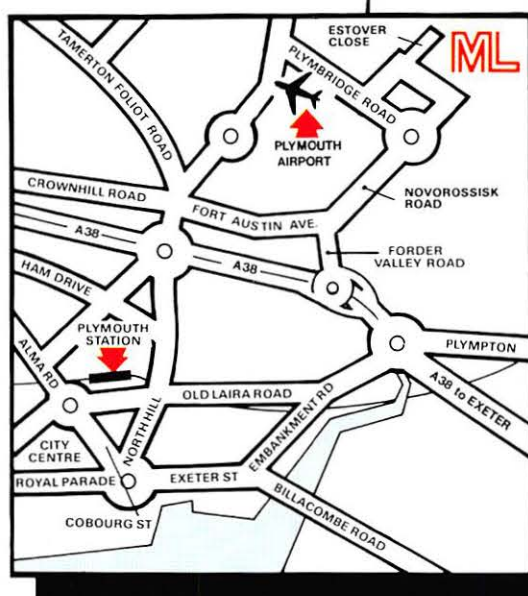
British Rail Board

Category A1 Quality

Control Organisation to BS 5750 part 2.

British Telecom

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